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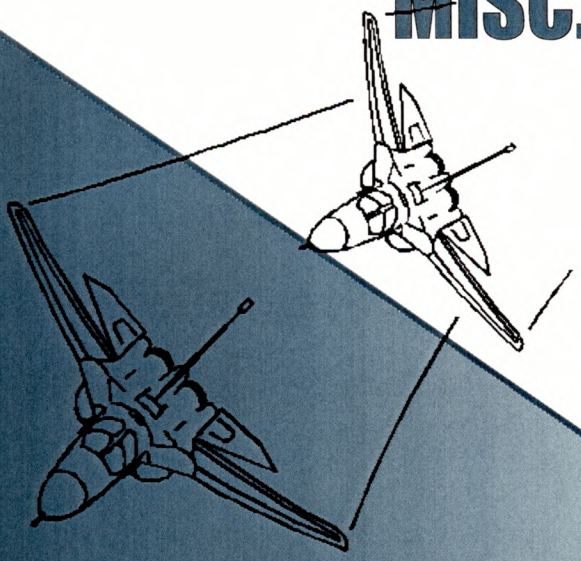

# F-111 HISTORY No2

NEWS PAPER CUTTINGS AND ARTICLES OF INTEREST TO MEMBERS WITHIN SRLMSQN

AN SRLMSQN PERSPECTIVE

111 NEWSLETTER

A report issued periodically by General Dynamics on activities in the F-111 variable-wing aircraft program.

# F-111 PRODUCTION MODELS ENTER FLIGHT TEST PROGRAM

The latest versions of the F-111 aircraft to incorporate all major improvements in the test program to date—the No. 12 F-111A Air Force fighter-bomber and No. 4 F-111B Navy air superiority fighter—are now in flight test.

The No. 12 F-111A in the 18-aircraft Air Force developmental series made its maiden flight at the General Dynamics Fort Worth division plant in Texas May 21 and has already completed its initial flight series.

The No. 4 F-111B of the five-plane Navy development program made its first flight at Grumman Aircraft Engineering Corporation's facility at Calverton, New York, July 25. The flight lasted 90 minutes.

Both aircraft have been lightened by several thousand pounds through intensive SWIP (Super Weight Improvement Program) efforts that began in January, 1964. They also have an improved engine-airframe match and increased wing lift, and have been equipped with the first operational crew modules.

"This is the first time we have been able to incorporate test-program refinements before delivery," said Frank Davis, president of the Fort Worth division. "Getting these aircraft into the air at the two-thirds point in the development program is something unusual and, we think, unprecedented."

*Continued on page 5*

# F-111A FIGHTER-BOMBER FLIES MACH 2.5 FOR FIRST TIME

A United States Air Force F-111A fighter-bomber has made its first Mach 2.5 flight—equivalent to 1,665 miles per hour or two-and-one-half times the speed of sound.

The speed was achieved at the Fort Worth division of General Dynamics July 9 by the No. 2 airplane in the 23-aircraft F-111 development program.

Sixteen F-111s—including 12 Air Force F-111A versions and four Navy F-111B versions—have amassed a total of more than 1,300 flight hours in the test program. Test aircraft have exceeded speeds of Mach 1.2 at extremely low levels and have taken off and landed in less than the required 3,000 feet.

The F-111's movable wings and advanced fanjet engines with afterburners make possible these apparently contradictory performance features. In addition to Mach 2.5 performance at altitude and supersonic speeds at sea level, an F-111 with its wings extended can make a slow-speed landing at 105 knots. This is more reminiscent of a 30-year-old DC-3 transport than a high-performance weapon system.

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***This is the fourth in a series of periodic newsletters recording the development, testing and production of the F-111. Subscriptions are available on request. Simply send name, title and mailing address to Newsletter, F-111 Program Office, Fort Worth Division, General Dynamics, Post Office Box 748, Fort Worth, Texas 76101.***

*The No. 4 F-111B—first Navy version to incorporate all improvements since the F-111 flight test program began—takes off on its first flight July 25. The first Air Force version with all improvements—No. 12 F-111A—made its first flight in May. Both aircraft are several thousand pounds lighter and have many other improvements.*

## FIVE SUBSYSTEMS FOR AIRCRAFT PASS FORMAL RELIABILITY PROGRAM TESTS

Five F-111 subsystems have passed their formal reliability qualification tests. The standards in these tests are regarded by some specialists as the most stringent ever required of subcontractors during development of a manned airborne weapon system.

The five subsystems are the terrain-following radar (TFR), produced by Texas Instruments, Inc., Dallas, Texas; lead computing optical sight, General Electric Company, Johnson City, New York; blanking pulse junction box, Novatronics, Inc., Pompano Beach, Florida; radar altimeter, Honeywell, Inc., Minneapolis, Minnesota; and antenna coupler, Collins Radio Company, Cedar Rapids, Iowa.

A total of 18 subcontractors, supplying mostly avionics equipment, are taking part in the reliability qualification program. Each subcontractor is visited periodically by representatives from the Fort Worth division of General Dynamics to monitor reliability performance. Fort Worth also reviews subcontractor reliability programs to point up problems and assure appropriate corrections.

Each F-111 subsystem must complete extended reliability tests, including exposure to a wide range of vibration conditions, power-on and power-off conditions and temperatures from 65 degrees below zero Fahrenheit to 160 degrees above. The terrain-following radar alone involves eight subsystems and requires a total of 1,404 test hours.

All subsystems must meet the same standards as the overall F-111A weapon system. The formal reliability and maintainability demonstration of the aircraft and its systems is scheduled to begin at Edwards Air Force Base, California, next year.

Other subcontractors participating in the reliability test program include Litton Industries, Inc., Woodland Hills, California, inertial bomb navigation system; Textron, Inc., Belmont, California, radar homing and warning; Garrett Corporation, Los Angeles, California, refrigeration and control set; Bendix Corporation, Los Angeles, California, flight control actuators, and Teterboro, New Jersey, central air data computer; McDonnell Aircraft, St. Louis, Missouri, crew module; Westinghouse Electric Corporation, Lima, Ohio, AC power;

Avco Corporation, Cincinnati, Ohio, countermeasures receiver set; General Electric Company, Utica, New York, attack radar, and Johnson City, New York, flight controls; United Aircraft Corporation, Windsor Locks, Connecticut, air inlet control; Sanders Associates, Inc., Nashua, New Hampshire, electronic countermeasures equipment; Electronics division of General Dynamics, Rochester, New York, electronic aerospace ground equipment; Link Group of General Precision, Binghamton, New York, flight simulator; Grumann Aircraft Engineering Corporation, Bethpage, New York, avionics equipment and electronic aerospace ground equipment peculiar to the Navy F-111B air-superiority fighter.

## F-111K DESIGNATION FOR RAF

General Dynamics has been notified that the official designation of the Royal Air Force version of the F-111 will be F-111K.

*Maj. Gen. Robert G. Ruegg, Assistant Deputy Chief of Staff, Systems and Logistics, USAF Headquarters, Washington, is briefed by E. E. Guthrie, General Dynamics pilot, before the general's first flight in an F-111A.*

*General John D. Ryan, Commander-in-Chief of the Strategic Air Command, gets ready for his first flight in an F-111A. Accompanying him is Major H. M. West, chief of Air Force flight operations at the Fort Worth plant.*

## NEW F-111A PILOTS: SIX GENERALS

The rapidly growing number of pilots checked out on the F-111 now includes Gen. John D. Ryan, Commander-in-Chief of the Strategic Air Command; Maj. Gen. Abe J. Beck, Director of Materiel, SAC; and Maj. Gen. Robert G. Ruegg, Assistant Deputy Chief of Staff, Systems and Logistics, USAF Headquarters, Washington;

Maj. Gen. Jack J. Catton, Director of Operational Requirements and Development Plans, USAF Headquarters; Brig. Gen. Kenneth C. Dempster, Deputy Director for General Purpose and Airlift Forces, USAF Headquarters; and Brig. Gen. Frank K. Everest, Director of Aerospace Safety, Norton Air Force Base.

# F-111 TURN-AROUND AVERAGES 50 MINUTES IN 14 FLIGHTS

How fast can the F-111A, coming back from a flight, turn around and take off on another? And how often, day after day?

Some answers to these questions were gathered recently during a series of 14 flights in a period of five days, two hours and 25 minutes at Eglin Air Force Base, Florida.

Average turn-around time, including post-and-pre-flight inspections, correction of discrepancies and refueling, was 50 minutes.

The flights were made over the land and sea ranges of the Air Proving Ground Center as part of the regular test program.

Objectives of the flights, apart from timing turn-arounds, were to improve maintenance procedures and to provide guidelines for the official reliability and maintainability demonstrations scheduled next year.

The tests also were used as orientation exercises for new pilots, each flight being carried out by a pilot flying the aircraft for the first time.

The No. 5 Air Force development aircraft used in these flights was in the air for a total of 15 hours and 40 minutes, including one hour and 39 minutes at supersonic speed.

The pilots of the aircraft performed a total of 111 wing sweeps, 57 full flap actuations, 19 speed brake actuations and 12 touch-and-go landings. On one of the 14 full-stop landings made by the "first-time" pilots, the plane was halted in well under 2,000 feet.

Each pilot also carried out an automatic let-down from 30,000 to 1,000 feet. With the F-111A, this is accomplished simply by setting the level-off altitude and steepness of descent in the lead computing optical sight. The aircraft levels off without help from the pilot.

Following are some typical comments on the aircraft's handling, wing-sweep and landing qualities:

Pilot A: *"The stability is outstanding. We were breezing along with the wings fully swept at 72.5 degrees when I moved them forward to 26 degrees. I didn't even have to touch the stick."*

Pilot B: *"The only way you know the wings are sweeping is from the gauge. Visibility is better than I expected."*

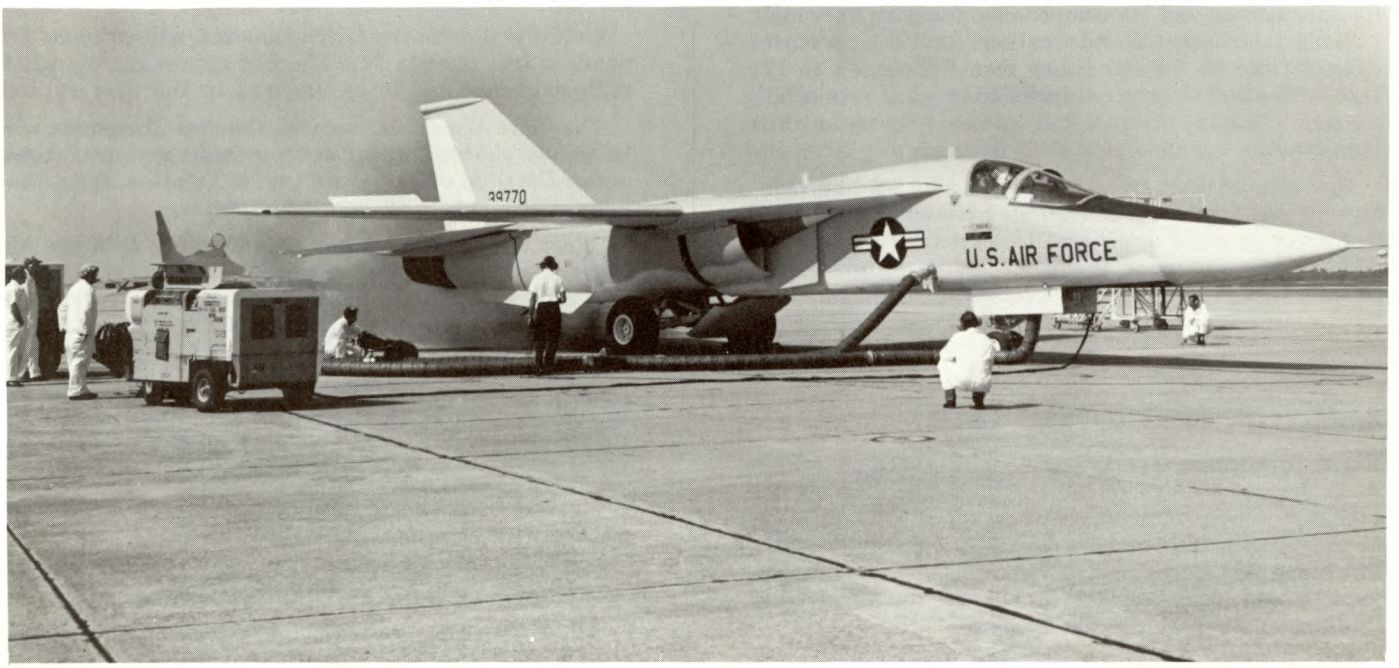
Pilot C: *"Smooth as glass. There won't be any trouble checking out men to fly this airplane—either for pilots in the left seat or systems operators in the right seat."*

Pilot D: *"It was hard to believe that we were down. It's like landing on feathers. Easiest first landing I've ever made in any airplane."*

The F-111A's electronic subsystems also were evaluated, including radar homing and warning, autopilot, countermeasures receiving system, navigation, attack radar and lead computing optical sight.

The operation was conducted with organizational-level maintenance support similar to the flight-line conditions of an operating command. The F-111's turn-around capability is inherently fast because its built-in systems require relatively little aerospace ground equipment. The airplane carries cartridges for starting its engines, devices for fast working-order checks, electronic equipment made up in modules that can be instantly replaced by ground crews working at shoulder height, and means for fast engine adjustment.

The 14 first-time pilots included 10 from the Air Force and two each from the Navy and the Fort Worth division of General Dynamics.




*The No. 5 development F-111A demonstrates the capability of the aircraft to start its engines without aid from ground equipment. Engines were started by self-contained cartridges during recent turn-around flights at Eglin Air Force Base. Hoses to the aircraft supply air conditioning.*


*Air Proving Ground Center crews at Eglin Air Force Base ready the No. 10 F-111A for another test during the airplane's 75 days in the environmental hangar of the USAF climatic laboratory in Florida.*

## ICE, RAIN, MINUS 65° TO PLUS 125° IN 75-DAY ENVIRONMENTAL TEST

The No. 10 test and development F-111A completed 75 days of environmental testing in the USAF climatic laboratory at Eglin Air Force Base, Florida, in July.

The tests were designed to determine how the aircraft, its subsystems and its components function in widely varying temperatures and weather. Test temperatures ranged from 65 degrees below zero Fahrenheit to 125 above. Weather simulation included tropical rain conditions in which the aircraft was sprayed with water while temperature was held at plus 85 degrees.

Environmental testing is being conducted and managed by the Aeronautical Systems Division of the USAF Systems Command at Wright-Patterson Air Force Base, Ohio. Test support is furnished by the Air Proving Ground Center at Eglin Air Force Base, Florida.

## RAAF MAN PART OF SSM TEAM

Royal Australian Air Force Squadron Leader Philip A. G. Bloom, on loan to the U.S. Air Force under the exchange officer program, is part of the F-111 team at the System Support Managership office at Wright-Patterson Air Force Base, Ohio. His job is to compile, publish and maintain the F-111 Aerospace Ground Equipment Support System Package.

RAAF personnel assigned to the F-111 program as members of their own organization are stationed at the Fort Worth division and at the SPO Office at Wright-Patterson Air Force Base, Ohio.

## AIR FORCE ANNOUNCES CONTRACT CHANGES FOR MARK II AND IIB AVIONICS

Amendments to the F-111 research, development, test and engineering contract that eventually will total about $147 million have been announced by the Air Force to fund development of the Mark II and Mark IIB avionic systems for advanced versions of the F-111.

Initially the contract amendments will provide for nominal increases in funding, but approximately $39.5 million is expected to be involved in the near future.

The Fort Worth division of General Dynamics will be prime contractor for both avionic systems. Autonetics Division of North American Aviation, Inc., Anaheim, California, will be subcontractor.

"Fort Worth division has been working with the Air Force since the inception of the F-111 program to insure that new advances in avionics are used to the fullest extent for continual improvement of the F-111 weapons systems," said Frank Davis, its president.

Incorporating advanced development and techniques in avionics, the Mark II will provide improved navigation, air-to-ground and air-to-air weapon delivery capability for the Air Force's F-111A fighter-bomber.

Mark IIB will provide similarly advanced capabilities for the FB-111 strategic bomber.

R. L. Lemmon has been named Mark II system program director for the Fort Worth division.

North American's Autonetics Division has named Earl H. Schaefer program director of the Mark II system and Dr. Donald E. Findley, assistant director. Travis S. Thomas will be Autonetics resident operations manager at Fort Worth.

## ATION OF F-111 BASE NETWORK GETS UNDERWAY AT 14 LOCATIONS

The Air Force has begun to establish the base network to support its newest groups of aircraft, including some bases for the F-111A and FB-111. The first delivery of the F-111A to the Tactical Air Command is scheduled early next year, and the first delivery of the FB-111 to the Strategic Air Command is scheduled in 1968.

A focal point for F-111 support will be McClellan Air Force Base, California, which has been designated to overhaul F-111 airframes. No less than $2.3 million will be spent in 1968 and $509,000 in 1969 to complete necessary McClellan facilities.

Kelly Air Force Base, Texas, will repair airborne navigational and communications systems for the new fighter-bomber. Tinker Air Force Base, Oklahoma, will service the Pratt & Whitney engines. Robbins Air Force Base, Georgia, will handle armament and electronic components. Newark Air Force Station, Ohio, will service inertial platforms in the program.

The Air Force also plans to increase the amount of land it holds at the Melrose Range, near Cannon Air Force Base, New Mexico, to permit the high-speed F-111 to make live firing passes during weapons proficiency training. About 21,000 acres are being added for this purpose.

The main FB-111 strategic bomber base will be at Carswell Air Force Base, Texas, near the Fort Worth division plant of General Dynamics. Six other FB-111 bases will be designated, but these have not been announced.

During Fiscal Year 1967, the Air Force plans to spend $901,000 to begin building support facilities at Carswell in anticipation of the first deliveries of the FB-111 in 1968. Initial construction at Carswell will include a jet engine test cell that will cost about $895,000 and a flight simulation trainer that is being altered for about $206,000.

*Radm. Raymond N. Sharp, commander of the Pacific Missile Range, looks into a test F-111B aircraft at the Hughes Aircraft Company's Culver City, California, plant. The F-111B is at Hughes for installation of the necessary avionics for the Phoenix missile system, being developed by Hughes for the Navy airplane. Hughes officials conducted the briefing, which included inspection by the admiral of the laboratories and flight line.*

*Vice President Hubert H. Humphrey visited Fort Worth recently and while at Carswell Air Force Base inspected an F-111A test aircraft. Richard L. Johnson, Fort Worth's director of flight and quality assurance (left), briefed the Vice President on the airplane. Listening to the description of the landing gear was Congressman Jim Wright (behind Mr. Humphrey).*

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### F-111 PRODUCTION MODELS ENTER FLIGHT TEST

*Continued from page 1*

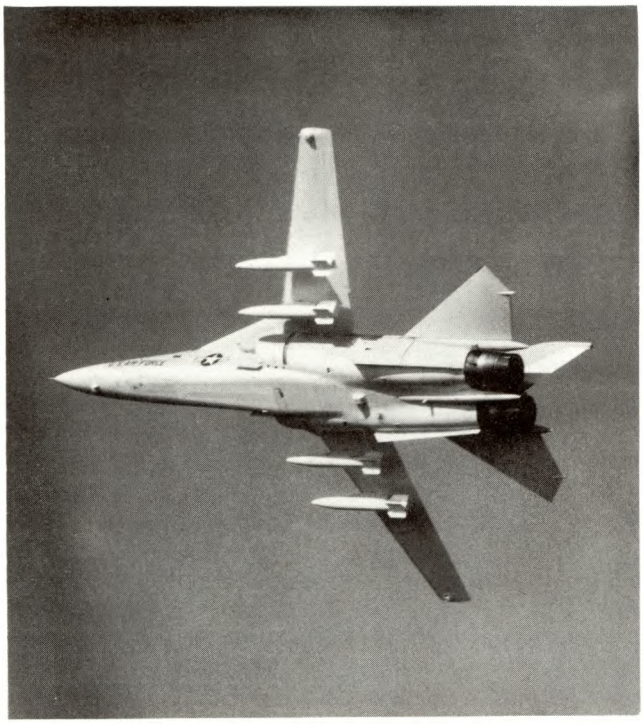
The No. 12 F-111A has begun flutter, stability and control tests. A second F-111A aircraft that incorporates the improvements and is designated the No. 14 airplane made its first flight July 20. It will be used in propulsion system tests. The No. 15 F-111A, third of the improved Air Force series, will be used for overall performance tests.

The improved engine-airframe match resulted from a joint effort by the Fort Worth division and Pratt & Whitney, producer of the TF-30 afterburning fanjet engines. General Dynamics altered the ducts to smooth the air flow to the engines. Pratt & Whitney reduced the sensitivity of the engines to inlet air distortion.

New flaps and slats are expected to increase the maximum wing lift by nine per cent. Flap and slat drives have been simplified.

All F-111s beginning with the No. 12 F-111A and No. 4 F-111B are being equipped with the self-contained escape-and-survival vehicle for the two-man crew. In an emergency, the entire cockpit and a portion of the wing are separated from the aircraft and carried down by parachute. Separation of the pod and safe landing can be accomplished at any speed or altitude. Pressurized and air-conditioned, the module can provide shelter on land or sea.

Additional improvements have been built into production version aircraft, including some that will further reduce drag.



*Four training weapons that simulate Navy Phoenix air-to-air missiles, which will arm the F-111B, were mounted on this No. 7 Air Force F-111A test airplane for weapon separation tests at Eglin Air Force Base, Florida. Inboard pylons swivel to keep the weapons parallel to the airstream during the wing sweep operation.*

## TWO F-111A TEST AIRCRAFT TO SERVE AS PROTOTYPES FOR FB-111 BOMBER

The FB-111 strategic bomber will be developed from the ninth and 18th F-111A test aircraft.

The No. 9 airplane, which made its first flight as an F-111A January 29, will be turned into a test bed for the bomber's avionic equipment. The No. 18, last on the assembly line of test and evaluation F-111As for the Air Force, will be the prototype air vehicle in the new FB-111 program.

First flights of both converted aircraft are scheduled for 1967. Authorization for diverting the two aircraft to the FB-111 program was issued by the Aeronautical Systems Division of the Air Force Systems Command, Wright-Patterson Air Force Base, Ohio.

The authorization was the first step in the Air Force's acquisition of the 210 FB-111 bombers previously announced by Secretary of Defense Robert S. McNamara. He said some $26 million of Fiscal Year 1966 funds would be used to initiate the development work this year.

The strategic bomber version will combine the airframe of the F-111A tactical fighter with the longer wing of the Navy F-111B air superiority fighter. The FB-111 will carry Mark IIB avionics equipment to enable the airplane to accomplish its role as a strategic bomber. Its landing gear will be strengthened for heavier loads.

The FB-111 will bring to the Strategic Air Command new ranges in speed (105 knots to Mach 2.5) and improved penetration capabilities.

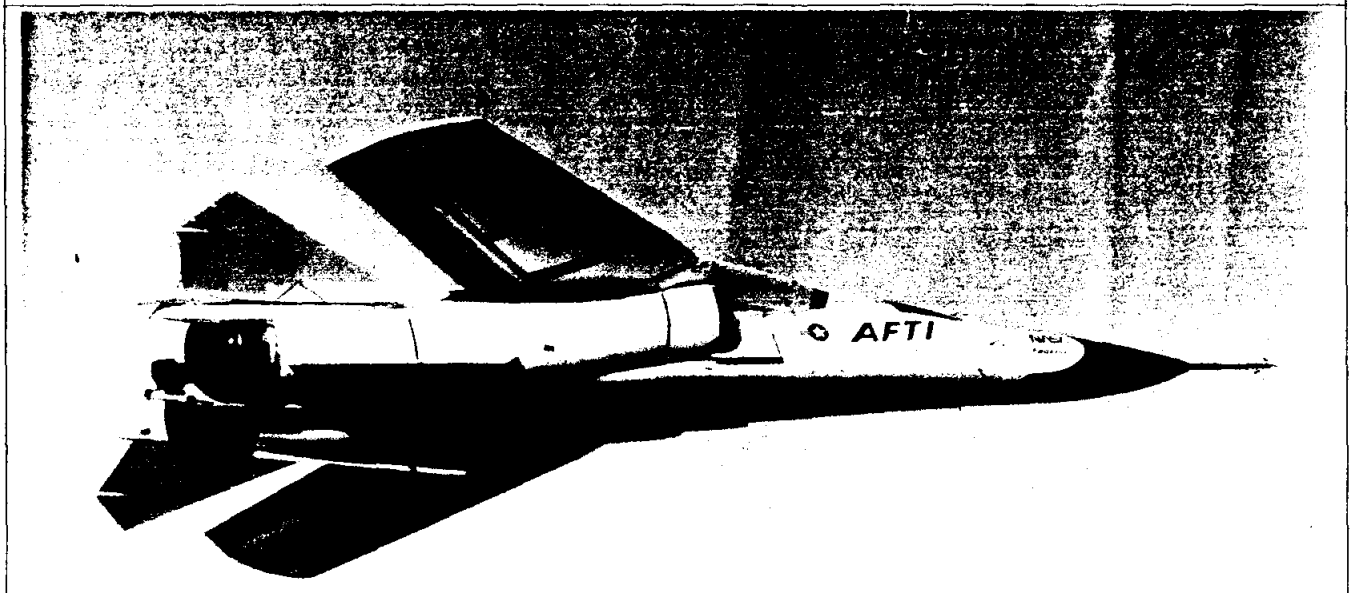
### F-111 FLIGHT LOG
### (To August 4, 1966)

| Airplane | Flights | Time | Supersonic Flights | Location |
|---|---|---|---|---|
| F-111A #1 | 122 | 149:00 | 85 | Edwards |
| #2 | 106 | 138:25 | 73 | Fort Worth |
| #3 | 102 | 205:30 | 12 | Edwards |
| #4 | 102 | 172:20 | 0 | Edwards |
| #5 | 68 | 109:15 | 17 | Fort Worth |
| #6 | 42 | 98:25 | 17 | Fort Worth |
| #7 | 26 | 38:05 | 4 | Eglin |
| #8 | 59 | 135:20 | 25 | Edwards |
| #9 | 52 | 81:30 | 18 | Edwards |
| #10 | 16 | 36:15 | 7 | Eglin |
| #12 | 8 | 11:05 | 0 | Fort Worth |
| #14 | 3 | 3:55 | 1 | Fort Worth |
| | 706 | 1179:05 | 259 | |
| F-111B #1 | 89 | 120:50 | 34 | Calverton |
| #2 | 4 | 5:15 | 1 | Calverton |
| #3 | 8 | 10:20 | 1 | Culver City |
| #4 | 1 | 1:30 | 0 | Calverton |
| | 102 | 137:55 | 36 | |
| Program Total | 808 | 1317:00 | 295 | |

*(76 flights Mach 2 or above)*

# Performance Gains Confirmed In Mission Adaptive Wing Tests

WILLIAM B. SCOTT/EDWARDS AFB, CALIF.




**Air Force and NASA will complete the mission adaptive wing (MAW) flight research program late this year. The General Dynamics AFTI/F-111's four automatic wing contour-control modes, which vary wing camber for better aerodynamic performance, are the focus of current evaluation flights.**

The USAF/NASA/General Dynamics F-111 mission adaptive wing flight research program has confirmed predictions that a smooth variable-camber wing will produce an approximately 6% performance improvement over a standard fixed wing for a specific point-design or flight condition. For certain mission profiles, overall performance gains up to 20% have been demonstrated.

During the last year, the advanced fighter technology integration (AFTI) aircraft has been flown with the mission adaptive wing (MAW) system in both manual (pilot-selectable) and automatic flight control modes. A total of 106 flight hours have been flown on the system, 58 in the manual mode and 48 in a combined manual/automatic configuration.

Final evaluations of two remaining automatic flight control modes will begin early this month and will be completed by late December when the research program is scheduled to end.

The automatic modes enable computer-commanded adjustment of the wing's camber or surface curvature by altering leading and trailing edge positions in response to varying flight conditions. These modes include:

- Cruise camber control (CCC), which shapes the wing for minimum drag in steady state flight, producing increased cruise speed and range capability.
- Maneuver camber control (MCC) for optimum wing lift-to-drag ratio, enabling high-g turns without stalling.
- Maneuver load control (MLC) to reduce wing bending during hard maneuvering by relieving loads on the outboard wing sections.
- Maneuver enhancement/gust alleviation (MEGA), which improves aircraft pitch response and provides a more stable weapons platform during gusty conditions (AW&ST Apr. 27, 1987, p. 133).

Only two of the automatic modes were flown initially—CCC and MCC—because a stabilon interface problem between the standard F-111 systems and some of the MAW automatic features precluded flying the other two modes. Those problems have been resolved and all four automatic modes now have been tested in flight.

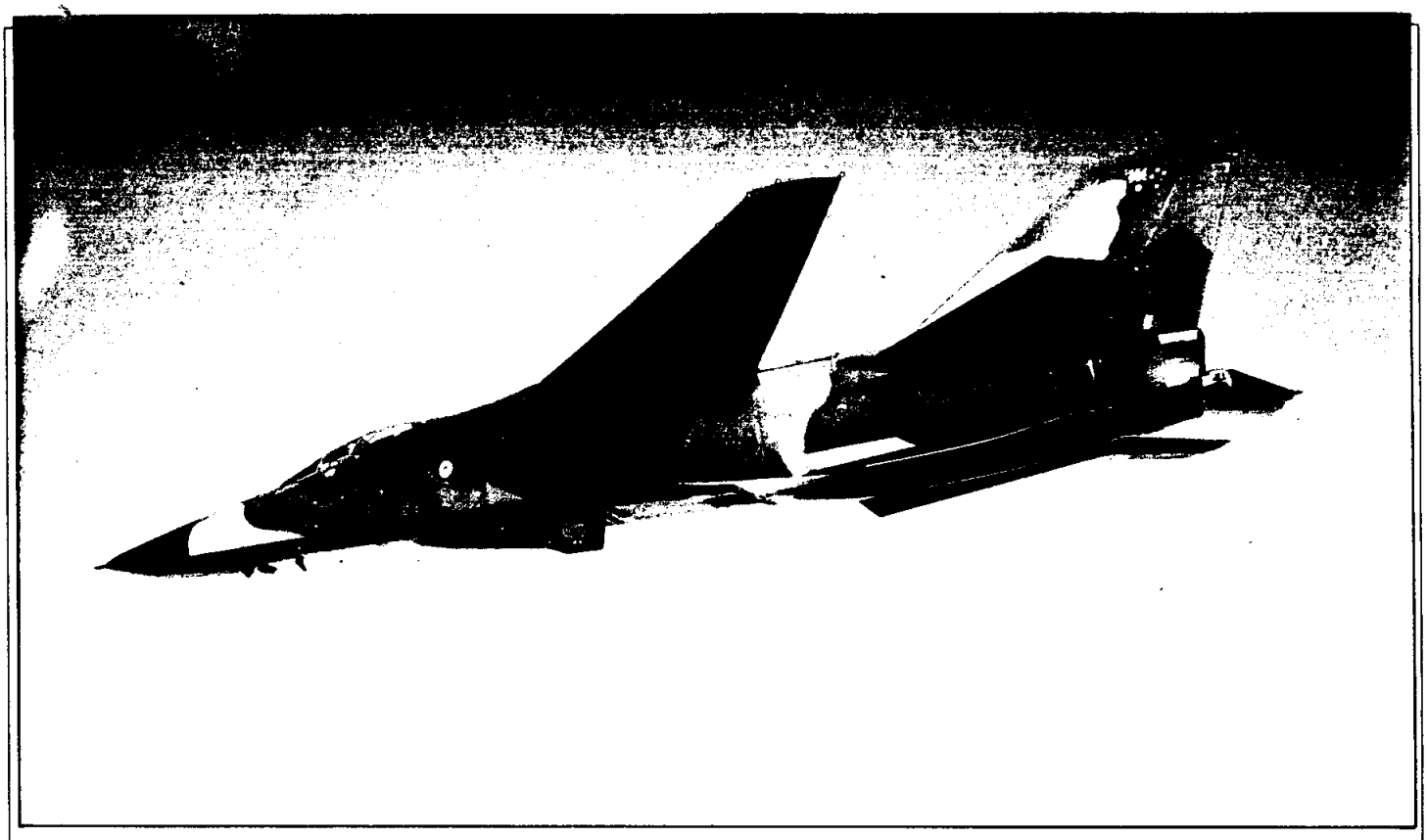
Louis L. Steers, NASA/Dryden's MAW project manager, said preliminary assessments of the maneuver load control and maneuver camber control modes indicate "there are no problems" with flight performance data matching wind tunnel predictions. Early results show "the automatic modes are doing what they're supposed to do, but final evaluations are not complete yet," he said.

The cruise camber control mode required software changes to improve speed control features, however. These CCC software changes are being implemented now by Boeing Advanced Systems Co.—which has MAW software development responsibility—and will be checked when the aircraft returns to flight status in early October after an F-111 mandatory maintenance phase is completed.

Flight tests of the MEGA mode also uncovered some instabilities in certain aircraft configurations during maneuver enhancement checks. These are being evaluated before additional tests are conducted. Gust alleviation portions of the MEGA mode have not been flown yet, but will be evaluated during the next flight period, Steers said.

Manual MAW system tests have verified that wing pressure distribution data obtained in flight agree closely with wind tunnel data. Similarly, flight data also have confirmed predicted performance and buffet onset improvements over the fixed-camber supercritical wing tested in the early 1970s on the transonic aircraft technology (TACT) program (AW&ST Nov. 24, 1986, p. 40).

A briefing to industry held in Dayton, Ohio, last July 21-22 was attended by a number of defense contractors, including those associated with the advanced tactical fighter program. Technology developed under the MAW program has been funneled to ATF contractors through the Air Force's Flight Dynamics Laboratory, a sponsor of the mission adaptive wing research effort, although it is uncertain what features are actually being incorporated in the fighter design. □



# Australia's F-111 update debate

As the RAAF looks at updating its F-111 fleet, **Mike Gaines** visits RAAF Amberley to examine the needs behind the programme.

Australia's location, perceived threats, and the limited amount of hardware available to counter them, dictate that the Royal Australian Air Force's operating philosophy be different to that of, say, the European air forces. The latter have the luxury of larger fleets of more varied types and their allies to help them, but Australia has none of these. Her allies are distant and any reinforcements would take a considerable time to arrive, given the politicking involved before the long-range reinforcement could even start.

In Europe a strike package could be set up with tankers, airborne early warning (AEW) jammers, air-defence suppression aircraft, and a fighter sweep to help the strike force aircraft penetrate to the target, hit it, and make good their escape. The RAAF does not have any tankers or AEW aircraft at present, although these force multipliers are at the top of the shopping list.

There are no dedicated combat-capable electronic warfare aircraft, no dedicated Sam killers, and the F-18 Hornets would be needed for air defence and so in short supply for escort missions. So the strike force, the F-111s, will have to handle their mission requirements alone, demanding true multi-role flexibility.

The Royal Australian Air Force's strike element consists of 22 General Dynamics F-111s, including four reconnaissance variants, based at RAAF Amberley, near Brisbane on the eastern seaboard. The F-111s are operated by 1 Sqn and 6 Sqn, which together comprise 82 Wing, the RAAF's strike element. 1 Sqn is the operational strike squadron, while 6 Sqn is operational but also handles F-111 type conversion, reconnaissance training, and operates the four RF-111As.

The RAAF F-111 is a hybrid combining the F-111A fuselage with an extended-span wing equal to that of the F-111F, but with the beefed-up gear, tyres, and brakes of the F-111K which was developed for the UK but eventually dropped. The four RF-111As are converted F-111As, again with the beefed up main gear and extended wingtips. Instead of the Pave Tack installation a reconnaissance pallet fits in the internal weapons bay, but the RF-111s can still deliver dumb weapons or toss laser-guided weapons for Pave Tack laser designator F-111Cs.

The F-111 force is at present awaiting the deliberations of a Defence Ministry sorely stretched by a tight budget. A decision in principle has been taken to update the F-111's avionics, but the actual details have yet to be worked out. It makes sense to fit the RAAF F-111s to the same standard and with the same equipment as the US Air Force's F-111s, but the RAAF is realistic enough to realise that this might not be affordable. However, the Service wants the F-111s to

**Above** *An RAAF F-111C shows its Pave Tack laser bombing module*

remain an effective force until at least 2010, so some updates are essential to keep the weapon system able to cope with future perceived threats.

The Australian Defence Ministry has already allocated A$160 million to the two-year F-111 Pave Tack incorporation programme. Upgrading the avionics will, it is estimated, cost another A$240 million. A bone of contention between the politicians and senior RAAF officers is that funds have not been made available to equip the F-111s with the data pod needed to enable use of the GBU-15 advanced laser-guided bomb. This system, which is a natural follow-on to the current weapons used, has been evaluated by the RAAF, and its purchase has been planned but still awaits ratification by the Defence Ministry.

## Analogue

The RAAF's biggest F-111 problem is that the aircraft have 1960s-vintage analogue electronics systems. These are quite accurate, but by present standards are slow to use, and user unfriendly. Worse, they are bulky and heavy and require lots of cooling air. Their serviceability is not as good as that of digital equipment, and they are difficult to work on. Any new systems retrofitted to the aircraft, such as the Pave Tack laser bombing system, are themselves digital and therefore need a tailormade analogue/digital converter interface which needs even more space and cooling.

The main thrust of the F-111 update will be to change the analogue navigation and weapons aiming system for a digital system, and at the same time replace the analogue flight control system computers with a digital system, tying in the whole with a 1553B digital databus. This would then considerably ease the introduction of digital-based weapons systems such as the GBU-15 and its data transfer pod.

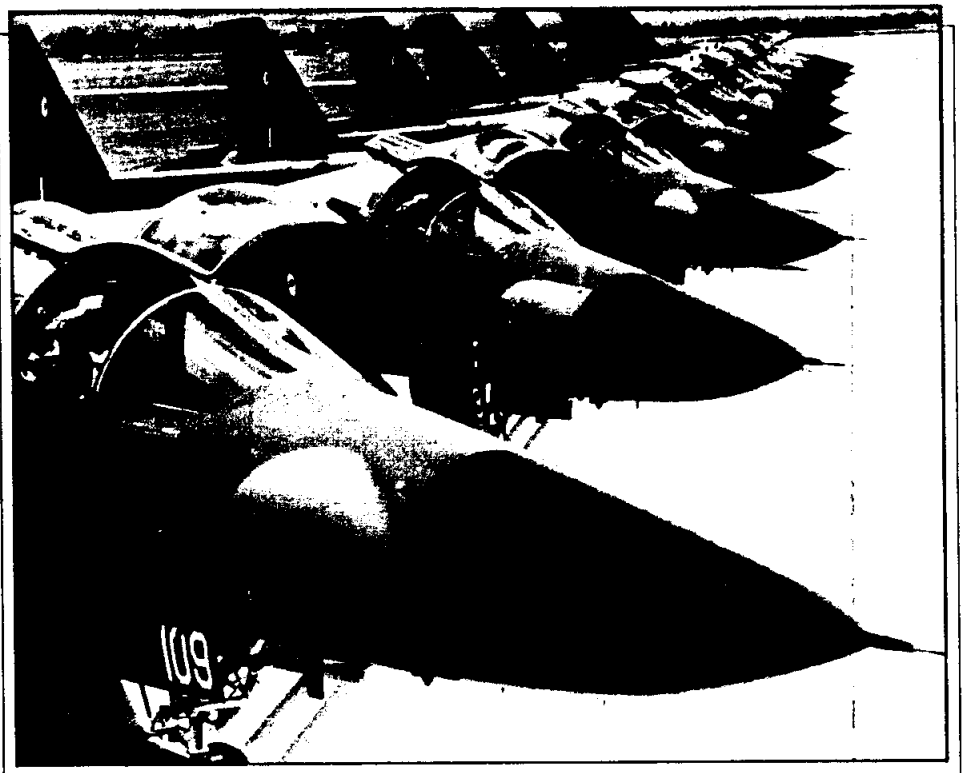
The roles and weaponry of 82 Wing reflect the total role flexibility required of the F-111s. The primary job is long-range unrefuelled conventional strike against high-value land targets such as enemy communications, headquarters, airfields, and econo-strategic targets such as refineries. The F-111Cs are equipped with the Pave Tack infrared search and track/laser designator pod. A secondary role is maritime strike and third is battlefield interdiction.

## Weaponry

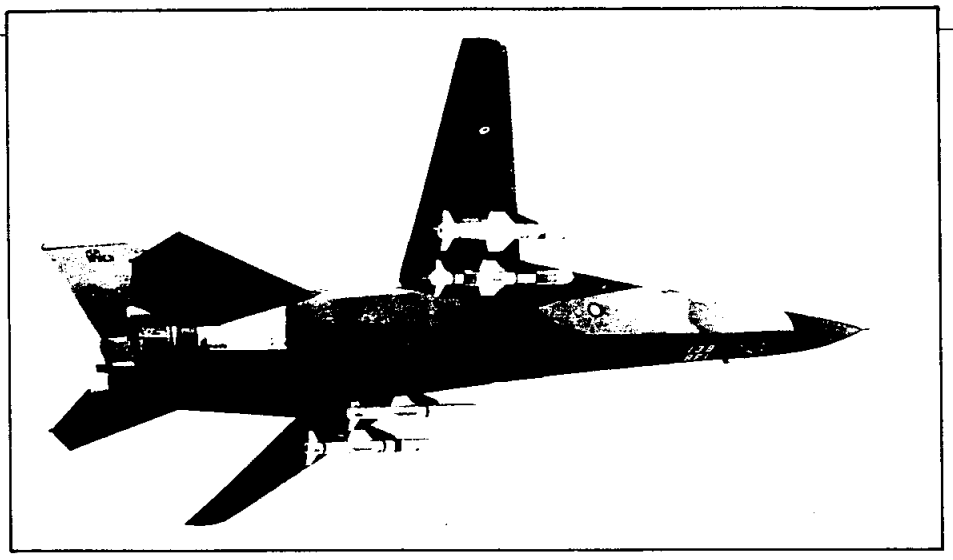
The F-111's current weapons suite includes the Mk.82 500lb HE iron bomb, which can be dropped either slick or in high-drag configuration, and the Mk.84 2,000lb HE bomb. With a flying tail and laser-seeking head fitted the Mk.84 becomes a GBU-10 and the Mk.82 is transformed into GBU-12. Both LGBs are part of the Paveway II family. The Rockwell GBU-15(V) uses the dumb body and 2,000lb HE warhead of the Mk.84, but allied to a larger cruciform wing which increases manœuvrability at low level and increases the bomb's range. The GBU-15 uses electro-optical guidance. A camera in the weapon's nose transmits a TV (daylight only) or imaging infrared (IIR) picture to the launch aircraft, and the navigator flies the weapon on to the target.

With GBU-15's extended range the aircraft must carry a datalink pod to receive the bomb's view and transmit flight commands to the weapon. GBU-15 is a logical and simple extension to the F-111's capability, but financing has not yet been found to fit it to the F-111 fleet. The F-111C could carry up to four GBU-15s plus the datalink pod. For the GBU-10/12, target identification and designation is with the Pave Tack module which is stowed semi-internally, replacing the General Electric M61A1 Vulcan 20mm Gatling-type cannon.

The latest weapon to join the F-111 inventory is the McDonnell Douglas AGM-84A Harpoon anti-ship missile; the F-111 can carry four of these. The Harpoons, purchased for the maritime strike role, are Block 1C-model missiles. This variant has extended range, and can be programmed with a number of waypoints, pop-ups, and pop-downs *en route* to its target. These features are employed to mask the direction from which the attack originated and to confuse the target ship's defensive systems.




**Above** *Part of Amberley's flight line.* **Right** *The F-111 weapons suite; the 20mm cannon can replace the Pave Tack module, or* vice versa



**Above** *An F-111C with four Harpoon anti-ship missiles.* **Below** *F-111 crews will get only 20hr a month training, reducing role proficiency*

The RAAF F-111C is claimed to be the only aircraft in service able to make full use of all of these Harpoon 1C features. The US Navy's updated Viking, the S-3B, will be the next to use it in service.

The F-111C's third role is battlefield interdiction, although the tactical economics of using such a large, expensive, and relatively unagile aircraft over a battlefield are questionable. The aircraft can carry up to 24 500lb bombs on pylon-mounted multiple ejector racks, or the Australian Kuringa cluster bomb. Pop and dive attacks are practised, although a high-speed low-level retarded lay-down or toss would be more survivable if circumstances permitted.

If the RAAF concept is to go for "aircraft packaging", rather than strike packages to ensure penetration to target, there are other areas of the F-111 that need to be brought up to date. The present suite of penetration aids, electronic countermeasures pod, chaff, and flares needs to be modernised. Also, the RAAF F-111 does not have any form of anti-radar missile and only an early-generation air-to-air missile for self-defence.

The current penaids are the ALR-62 radar homing and warning receiver, which the crews describe as "OK", and the ALQ-94 electronic countermeasures pod, which needs replacing by an electronically more extensive, faster, and more agile jammer pod. The chaff and flares are disposables, and can easily be improved on as necessary.

As for defensive weapons, the Vulcan cannon have been replaced either by Pave Tack or by the reconnaissance pallet. Although the aircraft have AIM-9 Sidewinders, these are the limited-aspect "B" models. "We want to put AIM-9Ls on a shoulder-pylon installation so we keep the pylons free for offensive weapons, but the flaps get in the way, so we are looking for another method at present," says Flt Lt Trevor "Boomer" Taylor, an F-111 instructor. "Of course, our job is to penetrate and put the bombs on the target, not mix it with fighters. We do not want to get into a fight. Our tactics are not to be seen, but, if we are, to go like hell and leave the threat behind."

## Tankers?

The primary method of F-111 evasion, very low and very fast, uses a lot of fuel (up to 128,000lb/hr in full afterburner), and without a tanker force, fuel regains the magical aura of pre-tanker days in other air forces. The F-111s can carry 600gal drop tanks, one each on up to six stations, including the fixed pylons. In practice they carry one each on stations 2 and 7, which do not swivel as the wing sweeps. These pylons are toed-in from the chord line, so they are streamlined at 26° wing sweep. The fuel from them is used first and then they are ditched, allowing the wing to be swept further back for higher speed.

The RAAF is having four VIP Boeing 707s converted to tanker configuration by Israel Aircraft Industries, but these will be drogue-equipped and so will only be able to tank the probe-equipped F-18 Hornets. The F-111 is a female receiver, and in its present configuration can only take fuel from a boom-equipped tanker such as the US Air Force KC-135 or KC-10. The Australians could fit a boom-and-drogue configuration, or a bolt-on probe, but this then puts the scheme into the loony world of politics. Tanking the defensive F-18s is OK, but tanking the offensive F-111s is not, apparently.

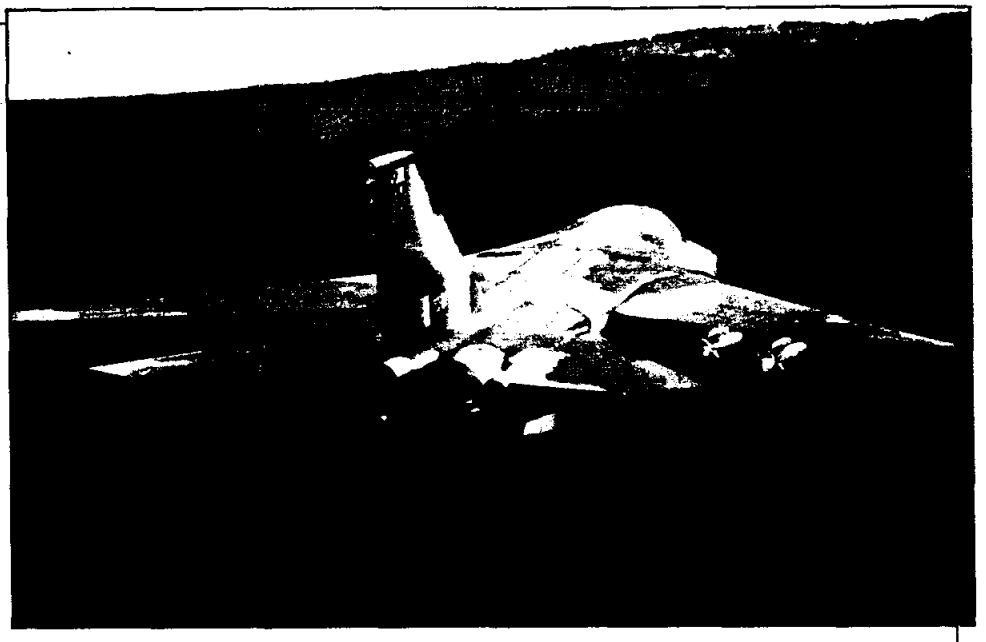
It might also make sense to pass on the RF-111As' reconnaissance role to the F-18 Hornets. These, with the 707 tankers, would have the range for strategic reconnaissance, freeing four airframes for modification to F-111C status with Pave Tack.

The core of experience in the RF-111As is dwindling fast. This is allied in part to the continuing exodus of experienced RAAF pilots to more lucrative jobs with the airlines, and partly to the continuing cutbacks in flying hours for the RAAF in general.

In the next financial year the F-111 fleet's flying time is to be cut by ten per cent to save money. With individuals flying only about 20hr a month it will be difficult to maintain crew currency on type, let alone in role. Passing on the reconnaissance role to the F-18 would therefore improve role proficiency by concentrating valuable training hours on the strike mission only.

As industry vies for the F-111 avionics update contracts, the Defence Ministry might take more heed of the aircrew. The updated F-111 will be a potent weapon well into the next century, but it will be of little use if the aircrew are not given the means of practising its use.

# The F-111 from the cockpit



*The "Pig" in its element—low and fast*

The RAAF aircrew call the F-111 "The Pig", not because of any adverse handling characteristics, but because it has a long snout which spends a lot of its time snuffling along close to the ground. The first thing I note on climbing into the F-111 is the view over the long nose, which sticks out way ahead of a very deep instrument coaming. The bottom edge of the curved windshield is about two yards ahead of me, so the view down and ahead is cut off. As F-111 instructor Flt Lt "Boomer" Taylor explains, "That's no problem with Pave Tack, the nav can look ahead on that, but with this [an RF-111B] we have a closed-circuit TV camera just aft of the nosegear so we can line up on the target. At high level the nose blocks the view of the ground ahead for about 20 n.m."

As we taxi out, I put our target co-ordinates into the archaic INS, which is a real pain to use. Boomer reads out the lats and longs. "OK, that's North 48 . . . ," I say. "No, mate, *South*. We don't have that much fuel," says Boomer. Red-faced, I crank in the numbers. You twist a spring-loaded knob, and the co-ordinate numerals click round on their drums. The harder you twist, the faster they go. Twist one way to increase, the other way to decrease. The system can store three destinations, to use as waypoints. It is time consuming and laborious enough to do while taxiing; later I'll find what a pain it can be.

We pull up into a max angle climb from the runway at 9 Alpha and 190kt. Boomer eases the wings back to 26° as we swing east to overfly Brisbane at 15,000ft, checking out the automatic terrain following (ATF) systems. We obtain clearance into the supersonic low-level corridor as we complete the checks with 200ft on the Set Clearance Plane and select "Hard" on the "Soft/Medium/Hard" ride selector. The last check is to see that the failsafe auto-pull-up works. Any faults in the ATF chain and the aircraft will pull up at 3*g*.

## Terrain following

"OK, all ready? Let's go down," says Boomer, engaging the ATF and pulling the wing back. The nose pitches down, hesitates, and pitches down again, Boomer is sitting with his hands on his knees as we descend rapidly. At 1,000ft the nose starts pitching up, giving us 2*g* until we are straight and level at 200ft. "Now watch this." The noise levers go forward and the wing sweeps even further back as the afterburners kick in. The sea rushes past, and as we go supersonic there is just the slightest tremor. Boomer hand-flies us down to 100ft and Mach 1·2. The sensation of speed is fantastic.

I look in the mirror: behind us a ball of spray erupts from the sea where our shock wave hits. But what really sticks in my mind are the fuel flow gauges. In full afterburner the left engine drinks 52,500lb/hr and the right 62,500lb/hr, with the turbine inlet temperatures hovering around 1,100°C. Taking a glove off, I note that the canopy is getting hot to the touch. We maintain this dash for a minute or so before pulling up and slowing down to a pedestrian 200ft/540kt.

## Auto-toss

We carry out a laydown attack on Snapper Point range, then swing around south for a 270° turn to head north for a Pave Tack auto-toss profile demonstration. After the 3*g* pull-up and release Boomer racks it round in a 4*g* manœuvre designed to allow the Pave Tack to continue lazing the target as we escape at low level back to the south. "Now let's update the nav kit," he says, reeling off a string of numbers for me to tweak into the "Present Position" number cruncher.

This is not so easy, because Boomer is pulling us hard round to cross over the centre target on the range, whose co-ordinates I am desperately trying to feed while fighting the *g*, avoiding the stick, and trying to keep my head up. It really is a pain compared with the modern systems I have used before. I get the numbers in and press the "Fix" button as we cross the target. The kit declines to accept it, so we turn hard and overfly again. This time it goes in, and the INS is updated.

We head inland towards the Great Dividing Range for some low flying. The terrain-following radar has a narrow beam width, so in Auto TF the aircraft often passes extremely close to high terrain on either side. Auto TF is usually a night/bad weather option. In daylight the pilots prefer to fly the TF, following pitch demand bars on the AHI and keeping an eye out ahead. Using the AHI will give the lowest terrain clearance (set in multiples of 200ft) for the ride quality selected: soft, medium, or hard. We select 200ft, hard ride, and bat along at Mach 0·9.

There are no problems with that, so we decide to do Auto TF. The system takes over, and Boomer sits back with his hands on his knees. "Pretty good, eh?" I am watching a hill dead ahead. "What? Oh . . . er . . . yes." The Auto TF pulls us up and, as we start to clear the ridge, pushes us down again. In hard ride it is a $-g$ push which lasts for several seconds and is absolutely delightful.

Approaching the next ridge Boomer removes a glove. As we unload to 0*g* again he tosses it in the air, where it floats gently backwards until the *g* comes back on to position us in a valley. "In hard ride the system leaves it later for the pull-up, to keep your exposure time down as you cross the ridge. At night I would monitor the E-Scope TF presentation and the nav looks at his attack radar display for terrain avoidance in azimuth. Look how close we pass to this feature ahead and you will see what I mean about the narrow TF beamwidth." A small mountain slides past *very* close. "Good thing about night flying; you don't see them," laughs Boomer, "but we would like a moving map display so we can better plan our terrain avoidance, I doubt if we will get it, though."

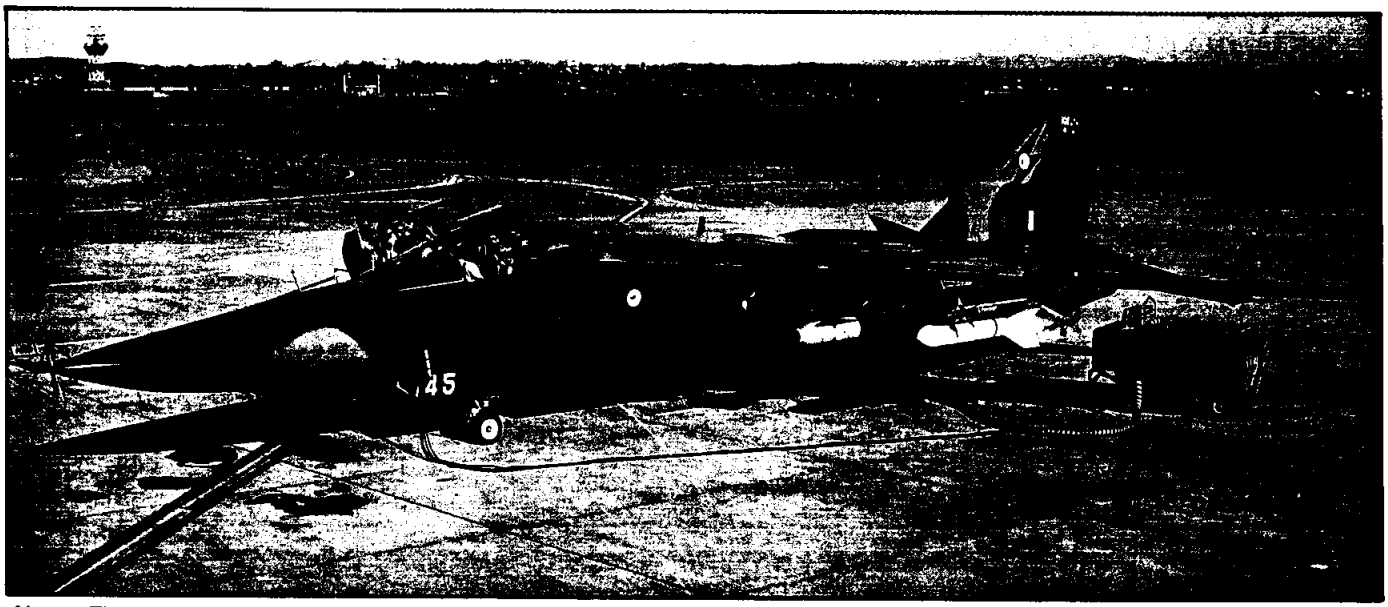
## Reducing the workload

After ten minutes, I am totally confident in the Auto TF and feel at ease. We are chatting unconcernedly about what we are going to do next, and we are also free to keep an excellent lookout all round. In short, the Auto TF leaves the crew free to think tactics and keep ahead of the game.

With a digital nav attack system the workload in the right-hand seat will be much lower, and the overall system accuracy will be much improved. Old the F-111 may be, but the digital update will rejuvenate it.

# The F111

# Updating for the 21st century



**Above:** *The port wing of an RAAF F111 armed with a 907 kg GBU15 TV glide bomb (inboard), an anti-ship AGM84 Harpoon and an air-to-air AIM9L Sidewinder.* **Below:** *The starboard wing with an AIM9L, a 907 kg GBU10 and a 227 kg GBU12, both laser-guided bombs.*

***Two months ago* Aircraft *told of the genesis of the F111 and the RAAF's $259 million plan to update its avionics for the 1990s. Now, GREG MEGGS reports on the successful completion last November of a $170 million Pave Tack update program for the strike force.***

The RAAF F111C pilot put the matter in perspective.

"The sort of difference we are talking about is that a maritime role, we would need 305 unguided 227 kg bombs or 57 unguided 907 kg bombs to sink a Russian Kashin class destroyer. In comparison, we would require 11 227 kg laser guided bombs or no more than two 907 kg laser guided bombs to do the same job.

"No more than two TV-guided GBU15 bombs would be required to sink the ship and with Harpoon, we would require between one and four," the pilot said.

He was describing the added striking power bestowed on the RAAF's F111 fleet at the completion of the Pave Tack modification program.

Pave Tack is a navigation and weapons delivery system which utilises an infra red detector for navigation updates and target detection. It also uses a laser designator to

pinpoint selected targets before an attack, using laser-guided bombs.

The system increases considerably the accuracy of the delivery of weapons, in any weather, day or night.

The Pave Tack update enables the RAAF's F111s to carry and accurately deliver, after self-designation from the onboard laser, three types of precision guided munitions: The 227 kg GGU12 laser-guided bomb, the 907 kg GBU10 laser-guided bomb and the GBU15, a 907 kg TV-guided bomb.

The upgrade package included clearance for the RAAF's two squadrons of F111s to carry and launch the devastating anti-ship AGM84 Harpoon missile.

Another benefit of the Pave Tack modification is that post-strike results can be recorded by the aircraft as it departs the target area. This negates the need for a reconnaissance aircraft to overfly the region to record strike damage.

The use of precision guided munitions means that far fewer weapons are required to *kill* any particular target. And, the increased accuracy of the delivery of these munitions also means fewer sorties are needed. Together, they will enable the RAAF to preserve valuable assets — aircraft and aircrew.

The RAAF used one of the twice yearly bombing practices by No 1 Squadron, at Townsend Island, off northern Queensland, to demonstrate the newly-fitted Pave Tack system's ability with a number of 227 kg and 907 kg laser guided bombs.

Wing Commander Peter Criss, then CO designate of No 1 Squadron, emphasised before the bombing runs that the F111 crews were inexperienced with the guided munitions system and should not be expected to achieve perfect results.

"You just can't put a TV guided bomb through a target unless you know what you are doing and you can't drop a laser guided bomb and get a hit unless you know what you are doing. The required skill level has gone up considerably with the Pave Tack modification.

However, despite the possibility of some waywardness being seen by the assembled press, the F111 crews demonstrated precision bombing at its best, with all bombs either passing through the targets before exploding or landing so close that a *kill* would have been assured anyway.

Wing Cmdr Criss said a better name for the Pave Tack and precision guided munitions might be "pick-a-window".

"We believe that with these weapons we have the capability of not just putting a bomb on target but putting a bomb through a selected window," he said.

Despite the advances which Pave Tack endows on the F111, many RAAF F111 crews feel the program did not go quite far enough.

Wing Cmdr Criss said: "We just spent $170 million on Pave Tack for three additional capabilities — TV, laser and Harpoon — but we can't train on one-third of that capability."

This is in reference to the decision not to provide the RAAF with any method to practice with the TV guided GBU-15.

"Experience shows that you cannot just bolt that bomb on and achieve good results on day one of the war. We are not saying that we want millions of bombs, rather just the data link pod to go under the rear fuselage and some captive-carriage rounds.

"We can then put a captive-carriage on one aircraft and the data link pod on another. By this method the first aircraft pretends to be a bomb and the second provides training in guidance," he said.

Pressing home the point in true fighter pilot fashion, Wing Cmdr Criss added: "That weapon to my way of thinking is fundamental to successful F111 operations, as it allows longer range strike and more chance of survival for the aircraft and aircrews."

Another weapon thought by the F111 crews to be extremely desirable is the high speed anti-radar missile (HARM).

Test firings of this Mach 3 missile have been successfully conducted from a RAAF F111 but as yet there is no commitment to fully integrate HARM with RAAF F111s. Nor has there been any move to procure stocks of the missile.

The crews feel that HARM should be integrated during the avionics update.

"We have cleared the missile for carriage and release; it would be stupid now that we know we can carry it, not to integrate it at the same time as work is proceeding on the avionics. It could then be done at a fraction of the cost," Wing Cmdr Criss said.

The RAAF F111s may be able to carry and fire HARM missiles but they are limited in the number of frequencies which can automatically scan for hostile radars. If fully integrated, the radar warning receiver (RAWS) will "talk" to HARM over the whole electronic spectrum and advise it of threatening frequencies, against which it can be launched.

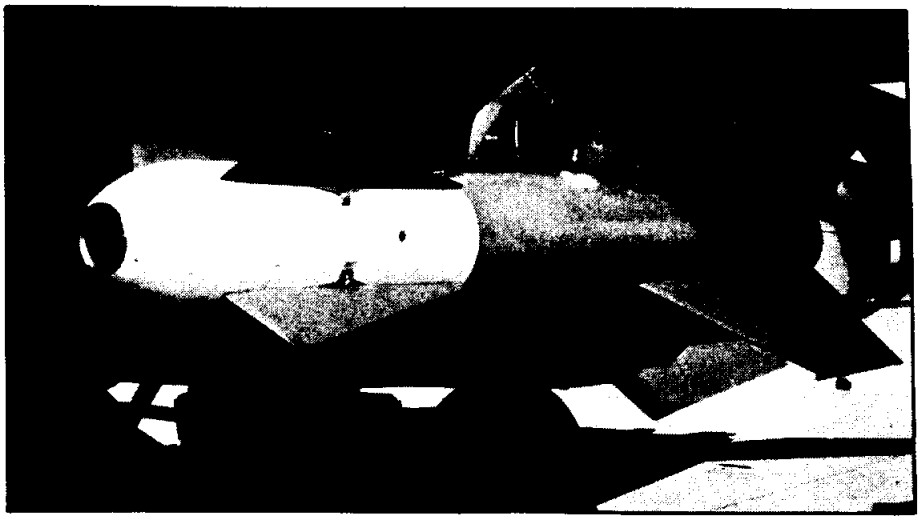
The two F111 squadrons have also been allocated a number of captive-carriage AIM9 Sidewinders which provide a marked level of protection.

F111 crews are adamant that both Sidewinder and HARM are there to protect the asset.

"We have a hell of a good platform in the F111 and it will be a crying shame if we lose any for want of a defensive missile," Wing Cmdr Criss said.

"It is better to spend a few million dollars for an insurance policy than to not spend it and lose an aircraft worth well in excess of $20 million and a crew."

Wing Cmdr Criss also commented on the push from some quarters to replace the F111s with later-model F/A18 Hornets. "There is not an aviator in the world who does not like strapping on a new aircraft and I am one of them. However, as sure as heck I don't want to strap on a new aircraft which is a step backwards — there is NOTHING in the western world today which can do what the F111 can.



*A close-up of a 907 kg GBU15 TV glide bomb.*

**"The arguments for the avionics update have been accepted by the Government and about $259 million has been allocated . . ."**

"No one can dispute that. It's a fact and that's how we won the argument to retain the F111.

"It was recognised, though, that if we were going to retain the F111, we had to do some updating. It is worth spending some money on because it is so damn good," Wing Cmdr Criss said.

The arguments for the avionics update have been accepted by the Government and about $259 million has been allocated for the work.

The avionics update is ostensibly not aimed solely at increasing the capability of the aircraft, rather to increase its reliability and maintainability.

The F111 now requires a great deal of intensive maintenance because its analogue systems are very old. Some systems have a mean time between failure (MTBF) of no more than three hours. The aim is to increase this to 20, 50, 100 or more hours. The proposed ring laser gyro has a MTBF of 4000 hours.

According to Wing Cmdr Criss, large chunks of the analogue systems will be replaced, including TFR, components of the attack radar and some sections within the flight control system.

"We presently have an analogue inertial navigation system and this will be replaced with a ring laser gyro, coupled through the global positioning system. Two multi-function displays, like those in the F/A18, will be installed in the cockpit and many of the communications systems will be replaced with state-of-the-art units," he said.

This is only a small part of a comprehensive program but the end result will be that the F111 fleet will be easier to support in terms of manpower and finances. More aircraft will be available for operations at any given time.

It is widely conceded that without this expensive update of the 1950s vintage avionics, the F111 will become increasingly difficult to support in the short term and almost impossible from 1995 onwards. Replacement of the analogue systems with digital systems will extend its life to at least 2010.

Final tender documents were released in late November. A contract is expected to be awarded by the middle of 1989.

It is expected that the update will be proposed in a variety of ways by the various bidding companies. The successful company will be required to modify a prototype aircraft to full standard in order to validate the package. This work is expected to start late this year or early next year.

It is expected that the work will be completed overseas as there are doubts about Australian industry's expertise in this area.

The prototype will undergo extensive testing by the contractor and also by the Australian Research Development Unit for up to two years.

The rest of the fleet will then be modified to the same standard. The RAAF insists that all production modifications will be completed in Australia, to ensure that the money stays in-country and that local expertise is developed.

The modification of the fleet should be completed by 1995.

RAAF F111C aircrew are convinced that their aircraft is the most potent in the immediate region and up with the best in the world. When the avionics update is completed, they are convinced that it will remain a visible deterrent until at least the end of the first decade in the next century and probably beyond.

# The genesis of the F111

***OCTOBER marked the 25th anniversary of the order for the F111 but the theoretical foresight that led to the RAAF's most potent strike aircraft goes back another 20 years, writes FRANK CRANSTON.***

*The F111's impressive armoury of missiles and bombs has been enhanced with the ability to launch laser-guided weapons.*

EARLY in 1944, with the Luftwaffe's need for fighters paramount, Messerschmitt conceived a swept-winged fighter. Construction of the unique P1101 began in July — it had a sweep-back that was adjustable between 35 degrees and 45 degrees when it was on the ground.

When WW2 ended, he P1101 was only about 80 per cent completed but the concept was immediately recognised by the Americans who whisked it away for detailed analysis.

By 1946, the P1101 was at the Bell Aircraft Corporation facility near Niagara Falls, New York.

In June 1951 Bell's version of the P1101 was rolled out as the X5 and two of these aircraft were used in a long and successful test program. Its wings could be adjusted while it was flying.

Not long after the Allied victory of 1945, Barnes Wallis, famous for the Wellington bomber, of geodetic construction, the "bouncing" bombs which took out the Ruhr dams and the monster "earthquake" bomb, announced a proposal for a variable-geometry airliner called The Swallow.

Promising experimental work was damned by a coalition of short-sightedness and economic stringency which afflicted the British industry, costing it virtually a generation of development.

But if Barnes Wallis was frustrated there were those on the other side of the Atlantic who could also see the benefits of a variable-geometry platform. Armed with the information revealed from the Bell X5, which looked (and apparently flew) a bit like an elongated barrel but it proved the concept. The ugly duckling caught the imagination of the US industry.

Boeing saw in it the potential for a supersonic airliner to rival the Anglo/French Concorde. General Dynamics saw a new generation of bombers.

In the early 1960s, the USAF and the US Navy needed a new strike aircraft — as did the RAAF and several other air arms around the Western world. In the US context Defence Secretary, Robert McNamara, thought he saw the chance to save the taxpayer millions by requiring the USAF and USN to buy the same machine, introducing "commonality", regardless of their traditional rivalries.

The McDonnell F4 Phantom had, after all, proved more than satisfactory for both despite being [illegible] primarily naval machine. The USN was expected to [illegible] the same [illegible] USAF had [illegible] over the Phantom. The combined production run would [illegible]

But the USN [illegible] preferred [illegible] The final production [illegible]

The RAAF [illegible] strike [illegible] squadrons [illegible] consumption [illegible] was designated [illegible] experimental [illegible] potatoes) TSR2, which was being developed to a RAF requirement for a low-range penetration aircraft able to sweep under hostile radars on its attack run.

Competition for the RAAF order was fierce, much of it on the political scene. It was a time when the British still regarded Commonwealth countries as their economic hinterland.

However, [illegible] old post-Imperial ties and opted for an American machine, the US Navy's North American A5 Vigilante which, unlike either of the other contenders, was in production and available. (The other two were still very much "paper" aircraft.)

The degree of political backroom infighting which developed over the choice is still confidential under the 30-year rule and will be fascinating to study when it becomes available. But the A5 would have been a disaster, as [illegible] pointed out, going out [illegible] after the RAAF was [illegible]

[illegible] with a snap Federal [illegible] Australia it was discovered [illegible] RAAF would sever the Imperial [illegible] with the USN.

[illegible] suggested by Defence Minister Allan Fairhall was "about £100 million (then about $200 million). This was [illegible] to Prime Minister, Mr Menzies, by [illegible] million.

As an [illegible] measure, pending delivery of the F111s, the USAF threw-in the loan of two squadrons worth of Boeing B47 bombers if Australia needed them.

It was the time of Indonesian "confrontation" with the newly-formed Malaysian Federation and the strategic situation was uncertain. The B47s — nobody in authority would say so — could have attacked Indonesian targets, including Jakarta, *en route* [illegible] and Singapore.

In the end, it was decided to decline the offer, the Indonesian situation having radically altered in the meantime. (There remains a school of thought which believes that Australia's intention to acquire such demonstrably superior capability illustrated to disillusioned Indonesian military officers that their Government's actions could drop them into a conflict which they could not hope to win).

There followed years of bitter wrangling about the capabilities and price of the F111s. Most of it was sheer politics. But there was a long delay before the RAAF was authorised to accept the aircraft which did not in fact arrive at RAAF, Amberley, until early 1973. The F111 was formally accepted and lauded by a Government which had, in Opposition, roundly condemned the swing-wing strike aircraft.

In 15 years of RAAF operations, the F111 has proved as good as the glossy brochures promised. In USAF service it remains the primary strategic strike force in Europe. Attrition losses of six RAAF aircraft — much better than the projections — have partly been made good with the purchase of four replacement aircraft from the USAF. The RAAF's F111 fleet of 22 includes four reconnaisance versions.

Now that the Government has accepted the suggestions of its White Paper, the RAAF F111s are about to be given a new lease of life to retain them in service until 2010 and beyond.

The swing-wing wonder is likely to remain in service until at least 50 years after it was initially ordered!

In September, tenders closed for a massive updating of the F111s electronic systems at a cost of about $259 million.

The RAAF's director general of material definition, Air Commodore S Clark, told *Aircraft*: "The aircraft is approaching 20 years of in-service life with us.

"The RAAF has found it a very competent, powerful aircraft. We have been extremely happy with its performance in general terms and the other air force which operates it has found the same thing. It's the sort of aircraft we intend to look to taking forward, certainly to 2010."

Air Cdr Clark said it was therefore imperative for the 1950/60s anologue avionics, which was increasingly difficult to maintain, to be replaced with modern, more capable digitally-based avionics.

**"In 15 years of operations, the F111 has proved as good as the glossy brochures."**

"The intention of the update is not so much to improve the capability of the aircraft but to ensure the retention of the current capability through the life of the type of the aircraft," he said.

One area in which the update is expected to be of considerable advantage, for instance, involves its anti-shipping Harpoon missile delivery system.

The F111 Harpoon requirement is peculiar to the RAAF — USAF F111s do not deploy Harpoon. The RAAF has proved the F111 capable of launching Harpoon in all the parameters of the weapon.

On the other hand, the RAAF will not follow the USAF Pacer development but will take "appropriate pieces" from it.

Pacer Strike involves the upgrading of the avionics in the USAF's D and F models with digital systems — the F model being about half digital and the D model about 80 per cent.

The RAAF upgrade is more extensive than Pacer Strike with its additional flight controls, a separate program in the USAF, plus radar modifications and changing some other unsupportable equipment.

Everything going into the RAAF aircraft has been tested by the USAF and is considered "off-the-shelf", except for some linking, which will be done in Australia because of different operational requirements, like Harpoon delivery.

The RAAF hopes its 22 F111s will have the new systems by the end of 1995.

The RAAF also has a peculiar advantage over the USAF F111s, in terms of airframes. The Australian "high time" aircraft (airframe flight hours) are three-to-five years behind the US "high time" aircraft — any airframe fatigue problems would be signalled to Australia well in advance, giving the RAAF a tremendous advantage in fleet planning.

"We are concerned solely with the avionics of the F111s," Air Cdr Clark said.

"Of the total avionics, we are probably going to replace about 50 per cent by weight or by volume but about 70 per cent by function.

"There are a lot of small, single-task analogue units throughout the aircraft, from single switches to single dials, backup instrumentation and so on, which will remain analogue. But the central core of the navigation and weapons system, including the radars — the attack radar and the terrain-following radar — the inertial navigation unit and its associated computer and displays, the ballistics computing controls for weapon delivery and its display system, will all be digitalised.

"One or two other smaller units like the radar altimeter, the RAAF radio and the compact airborne video recorder will be replaced, too. They are not manufactured any more. We have a problem because we are talking about a small number of units.

"One of the things that was considered early on was if we could reverse engineer a lot of the equipment in the F111 in Australia because that would give us defence self-reliance and supportability all in one hit.

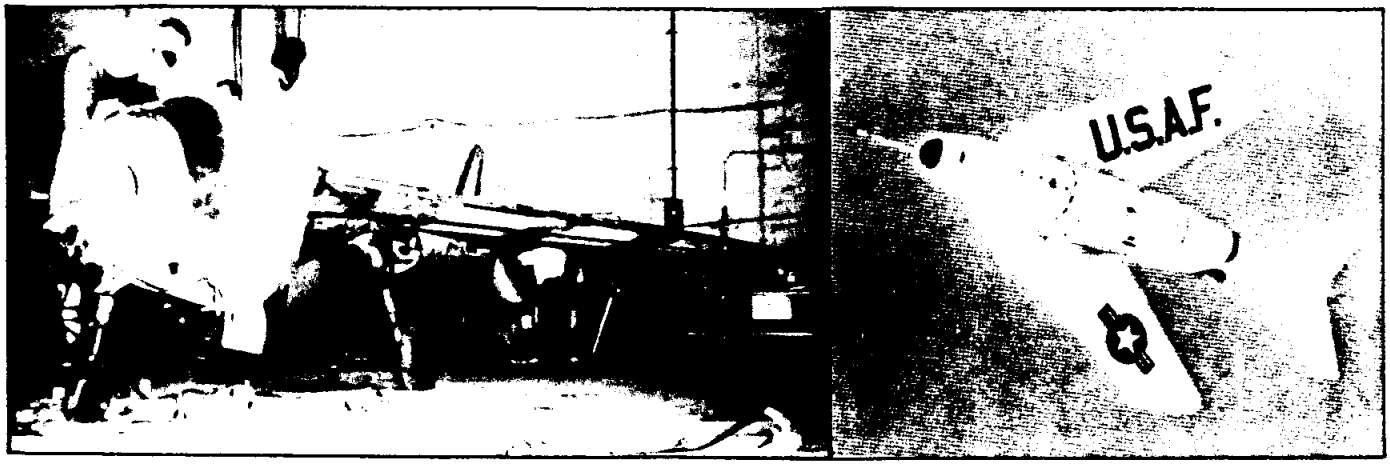
"The big problem is that we are only talking about 20 to 30 units in most cases so it is simply not worth an Australian company starting up a production line to produce those peculiar units which do not go into other aircraft," he said.

One major change will be to replace the analogue flight control system with a digital update featuring triple redundancy.

The RAAF hopes to be in a position to award contracts in August next year. It's a tough schedule but by 1995 the RAAF's F111s will be guaranteed at the "sharp end" for at least another 15 to 20 years.

This is a tribute to its designers, builders, operators and above all, to whoever persuaded the Government in 1963 that the the A5 was the wrong aircraft.

**Aircraft presented an exclusive report on the RAAF's F111s in September 1987.*




*Left: The Messerschmitt P1101 80 per cent completed at the end of WW2. Right: The US version, Bell X5, with wings fully swept back.*

# 'Aardvark' in Aussie

Perhaps because of its troubled early life, the F-111 never received a name. Generally it is called the 'One-Eleven', like the British civil airliner, though a few even speak of the 'One-one-one' (bringing memories of Heinkels of long ago). The only popular name is an unofficial one; somebody thought that the long, probing nose resembled the African ant-eater called an aardvark, maybe so that in any alphabetical list the F-111 would be well placed. Of course, the aircraft is found only in the United States, England, Australia and South Korea, where there are no aardvarks outside zoos. I consider this extremely important aircraft deserved an official name — such as Attacker, Penetrator or Striker — and definitely a new number in the 1962 combined-services numbering system, to lift it right out of the controversial past. Obviously, this number should have been prefaced by an A or B, rather than the inappropriate F.

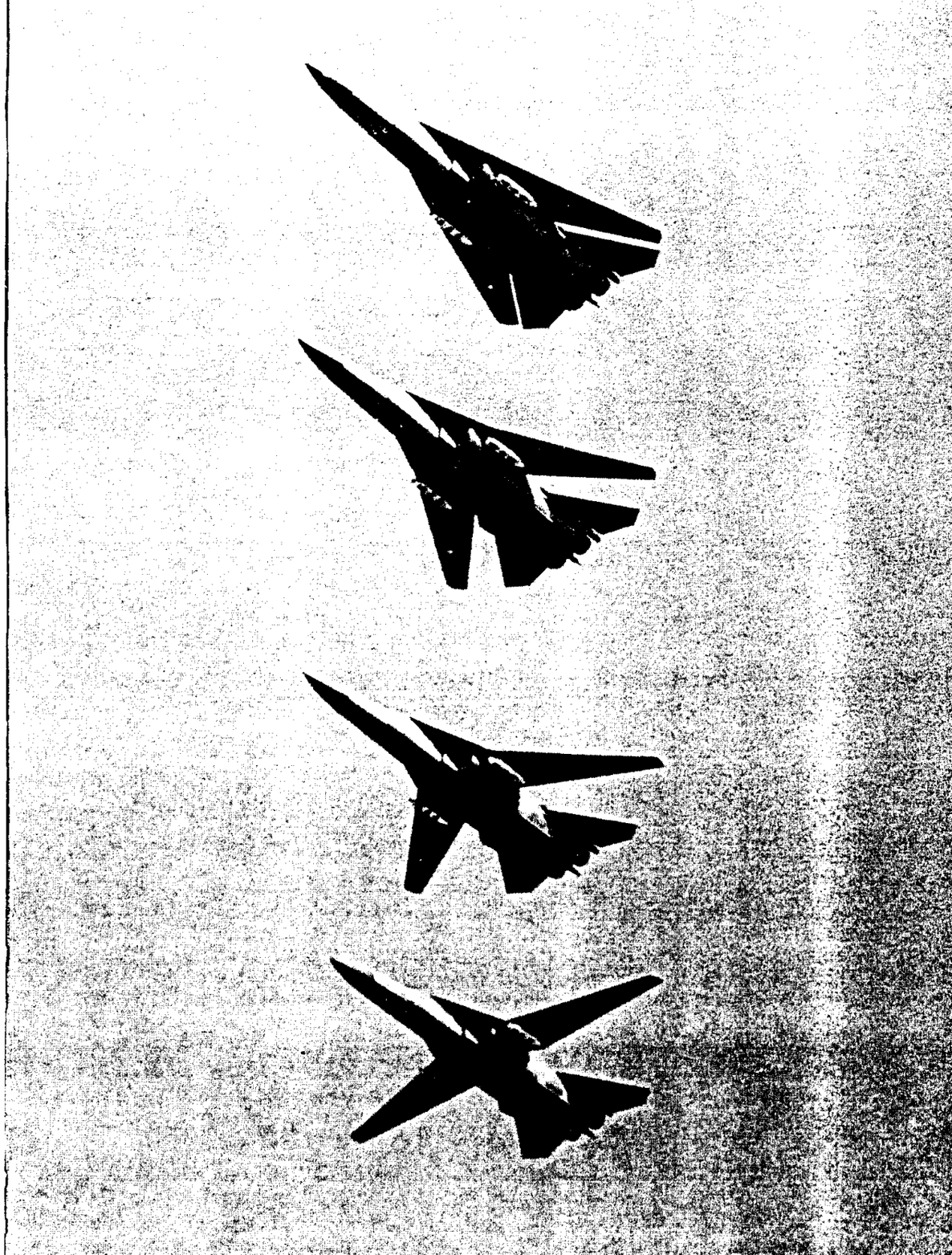
Never was an aircraft more inadequately designated, but this was the least of the problems for the only export customer. In 1963 GD told me they expected 'between eight and 12' countries to buy different versions of the F-111, and some of the long-term company planning was based on these foreign sales adding to the domestic programme of 1,726 aircraft to take the total to considerably more than 2,000. On a more nebulous basis it was planned that the existing aircraft should during the 1970s lead to a directly derived further generation to continue production in the 1980s.

With the backing of the US armed forces, which at that time had shown no inclination to buy jet-lift V/STOL aircraft, GD expected to sell the F-111 widely in Europe no matter whether the numerous V/STOL projects of the early 1960s came to fruition or not. There were several other prime sales targets, and none was more important than Australia, which wanted to replace its ageing Canberras. In 1958-62 it had seemed self-evident in the Department of Defence in Canberra that the RAAF's Canberra-replacement would be the same as that of the RAF: the purpose-designed TSR.2. Several fruitful discussions were held at air force and ministerial level, and there is no reason to doubt that the British low-level reconnaissance bomber would have met all the needs of the RAAF. But by 1962 the Australians were becoming very interested in the American TFX programme, which appeared to offer something extra. It used this at first as a stick with which to beat the British and thus minimise TSR.2 development delays or escalation in costs. In February 1963 the Aussie Minister for Air, David Fairbairn, said 'The RAAF cannot wait for TSR.2. It must replace its Canberras within two years.' He did not mention the exciting TFX but said his department was looking at aircraft that could be bought direct from current production, and named the A-5 Vigilante and F-4 Phantom from the United States and Mirage IVA from France.

In August Britain announced increases in the TSR.2 order-book, and the following month British Air Minister Hugh Fraser went to Canberra to offer 25 aircraft at a price, without spares, of a mere £65 million, with deliveries alternating with those to the RAF, plus an option of a V-bomber loan in the interim. But by this time the British Labour Party had singled out TSR.2 as a programme they wished to cancel, for reasons that were emotional rather than rational. The Australians recognised that they dared not plan their defence strategy for the next 30 years on a programme that might suddenly be terminated, and immediately sent a team to Washington to talk F-111. On 24 October Fairbairn very quickly signed for 24 of the American aircraft at a price of US$90,749,040, for delivery between July and November 1968. Obviously the over-riding need to replace the Canberras 'within two years' had been forgotten.

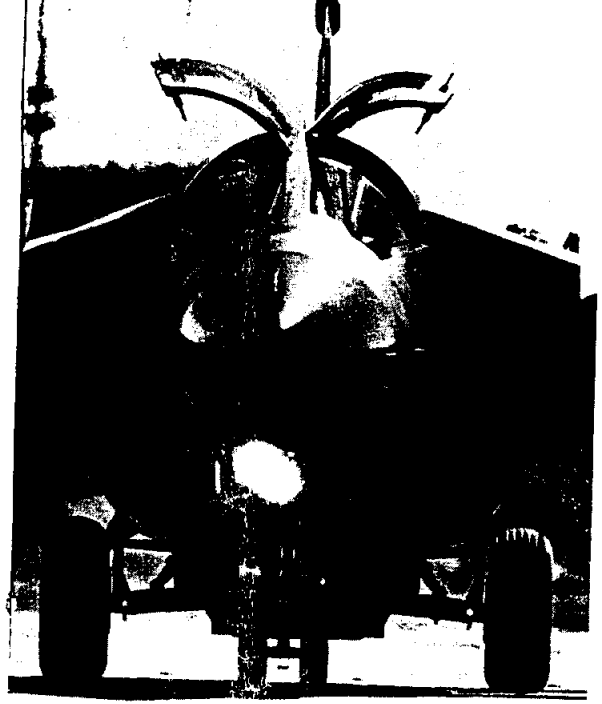
Prime Minister Menzies heaved a sigh of relief. The F-111 was American, with massive procurement planned for both the US Air Force and Navy, so it was taken for granted it could be relied upon to be ready on the planned day and at the right price. He said 'No government could spend money on anything else'; and his Defence Minister Athol Townley, stung by someone who said the price might escalate, retorted 'There is far more chance it will be reduced, because our figure is based on the present production run'. Hundreds more foreign sales were confidently predicted. Nobody bothered to write a single clause in the contract to offer protection in the event of trouble.

Needled at the apparent great success of the F-111 purchase by the ruling Liberal-Country Party the opposition Labor Party immediately denounced it as



*Right:* Unusual formation, for display purposes, by four Amberley Aardvarks. Each aircraft is carrying two practice-bomb containers. / *RAAF*



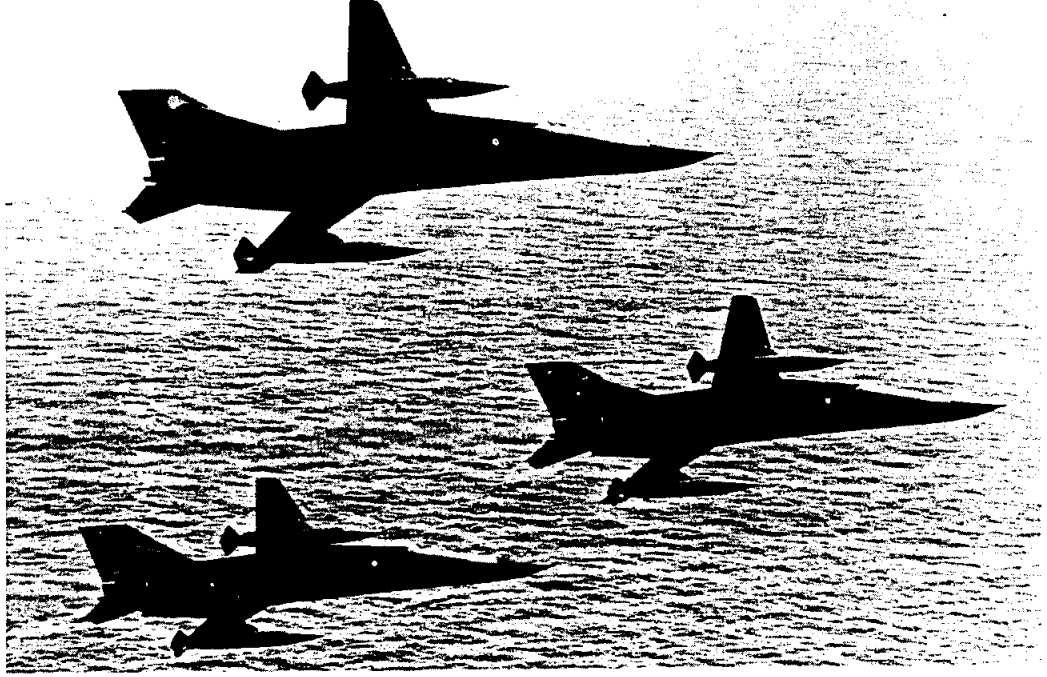


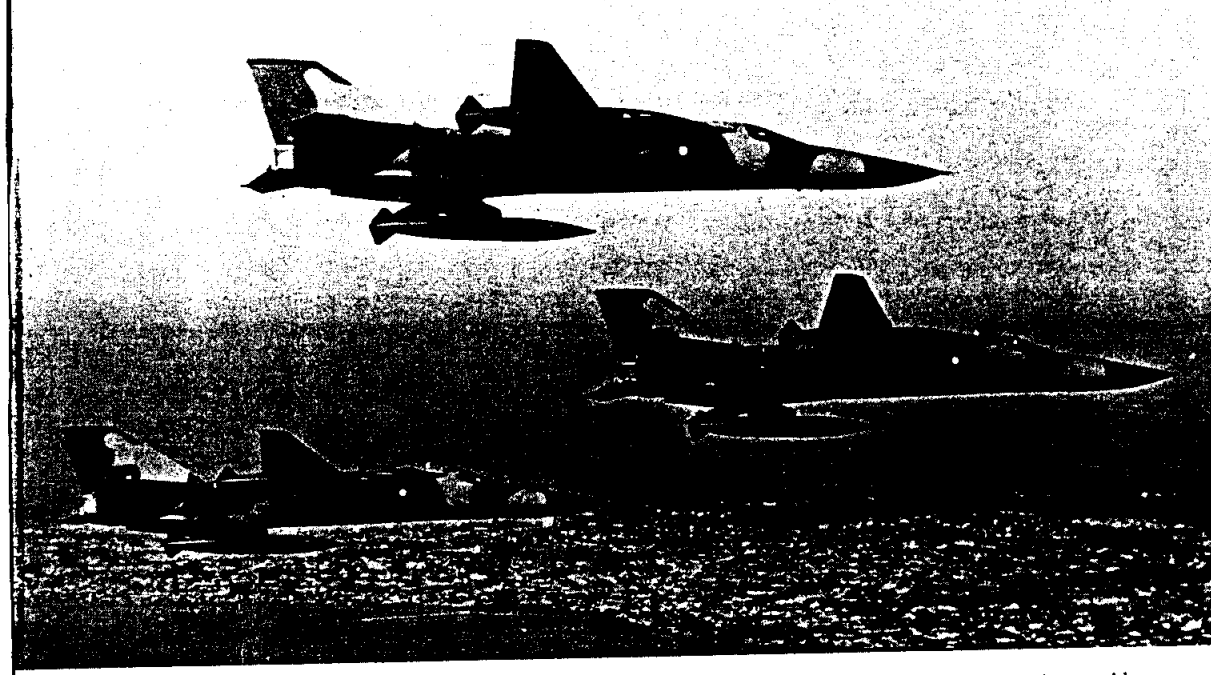
*Above:* Head-on we get a good view of the bird's fat tyres, which last on average more than 100 missions, and unusual width of fuselage for so fast an aircaft. Taxiing lamps appear to be mandatory even in bright sunshine. / *RAAF*

*Left:* They call this bit of Queensland, near Brisbane, Australia's Gold Coast (for the best of reasons). Nos 1 and 6 Sqn are based a few minutes away as the F-111C flies. / *RAAF*

'a vote-catching bid' (which gradually came to seem extremely ironic). To help tide over the former Canberra squadrons in 1963-68 the US government offered the lease of B-47E bombers withdrawn from service with Strategic Air Command, but the RAAF realised it would incur large costs on top of the hire charges in trying to put this aircraft into operational service. In July 1966 new Minister for Air Peter Howson announced that in early 1970 six of the RAAF swing-wingers would be flown back to the USA for conversion as RF-111 reconnaissance aircraft. Conversion would involve removing the weapon-bay doors and fitting into the weapon bay a large multi-sensor pod for surveillance to several miles on each side of the flight path with cameras, radar and infra-red linescan (which records TV-type pictures in which cooler regions are darker shades and hotter places look light). Howson said 'The striking power of the RAAF will not be affected, because the six modified aircraft can be reconverted to the strike role within hours'. The RF-111A, as the proposed US Air Force reconnaissance aircraft was designated, had been announced in December 1965. With exceptional design range and good penetrative capability the F-111 seemed well suited for use as an advanced reconnaissance machine, and a major development programme was put in hand for the multi-sensor pallet, with bulged radome and optical/IR viewing windows, and for a digital computer to manage the systems and relieve the workload on the weapon-system operator. The 11th F-111A was rebuilt as the prototype RF-111A, flying on 17 December 1967. Altogether the programme cost US$118m, and the RAAF paid additional sums in its regular progress payments towards their expected RF-111 costs of $A7,980,000. But the prototype was the only RF model ever to fly. Neither the USAF nor the RAAF has yet received a single reconnaissance pallet, though as described later the RAAF still wishes to.

In December 1966 the designation of the Australian aircraft was announced, logically enough, as F-111C. It was disclosed that it would have the long-span high-lift wing of the Navy F-111B and a new landing gear with stronger legs and larger tyres and brakes, such as was then being developed for two further models, the FB-111 and F-111K. These features were claimed to 'significantly increase the range and payload' compared with the F-111A. Another difference is that, unlike USAF tactical versions, the stick in the right cockpit can be unclipped and removed. In February 1968 Peter Howson announced that F-111C training equipment had been flown in to RAAF Amberley, Queensland, where US-trained NCO instructors were already teaching future ground crews. Several large systems rigs that duplicated aircraft functioning systems were in full use, a flight simulator was on order, and after further training courses in the USA had been completed the whole ground staff would be ready to receive the 24 aircraft in September-December (a slippage in timing of about two months). But in May 1968 doubt had been cast on even this schedule by the losses of aircraft in the USA and Vietnam, and a specialist team led by Air Vice-Marshal E. Hey, Air Member for Technical Services, spent three weeks talking in Washington, at GD and at Nellis. The Minister for Air, Gordon Freeth, said that Australia would not accept delivery until the F-111Cs had been 'thoroughly inspected and tested'. Allen Fairhall, Minister for Defence, emphasised his country's problems: 'While it may be competent for the United States authorities to put their aircraft into service within a few months on a reduced period of test, they have readily available to them facilities for structural modification, whereas if a need should arise for modification to our aircraft we would face tremendous difficulties'. What made this ironic was





*Above:* Two shots of the first vic of three C-models to nose across the Australian coast at Brisbane, on 1 June 1973, after an 18-hour flight from Nellis. / *RAAF*

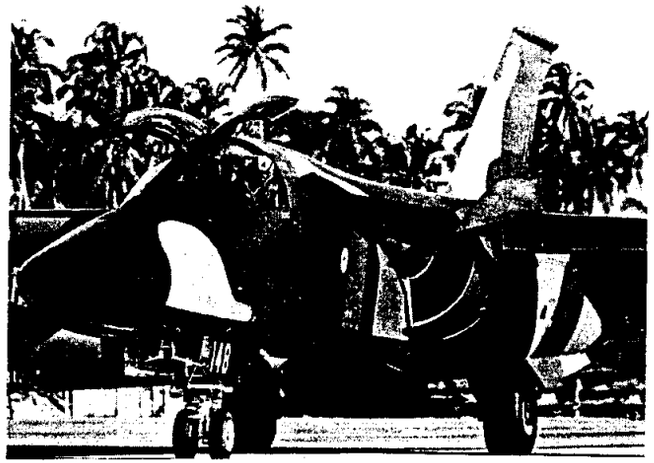
*Right:* Aussie champers for Air Commodore David Evans, CO of the 3,000-strong Amberley base (largest in the RAAF), after his first F-111C solo. Like many base commanders he considers it desirable to keep in touch by doing — who wouldn't, given the chance? / *RAAF*

that the Australian F-111Cs were eventually to be the only service-delivered aircraft not subjected to individual structural testing.

The first F-111C flew in July 1968, with the other 23 closely spaced behind it on the Fort Worth line. What happened next was odd. After being test-flown by GD, USAF and RAAF pilots, it was accepted by the Australian government at a formal ceremony in September 1968. It was then returned to the US Air Force and, followed at intervals by the other 23, taken to pieces and put into storage. The fuselages were parked on their own landing gears at Carswell AFB, the wings were stacked in the GD plant, and the avionics (which were identical with those of the A) were stored in a constant-temperature hangar. While the air and ground crews trained in Australia — over and over again with nothing but engineering manuals, films and systems rigs — the future of the F-111C force depended on the outcome of the USAF structural testing. Every time a wing box cracked it made headlines down under, and in July 1969 Defence Minister Fairhall said that 'until there has been a complete technical evaluation of the results of the tests just concluded it will not be possible to make any detailed comment as to the bearing of these tests on the future of Australia's aircraft'. The usually forthright Aussies seemed to be suffering from a severe case of indecision. Meanwhile, the price kept rising. In 1966 the Australian Auditor-General gave his estimate of the total price as not US$90.75 million but US$216m. In 1968 Fairhall said 'It could cost US$300m', and in 1970 the price had reached about US$320m.

In July 1969 the Aussies, after months of harassment by their national media, decided to send a powerful delegation for what were announced as 'Top Level Talks' (with initial capitals). The team included the Chief of Air Staff, Air Marshal Sir Alister Murdoch; the Secretaries of the Departments of Defence and Air, Sir Henry Bland and F. J. Green; Air Vice-Marshal Hey (whom we met earlier); and the Chief Defence Scientist, Arthur Wills. For many weeks previously a technical team from the RAAF and Department of Supply had been studying the fatigue testing in the United States and wondering what kind of message to send to their government. Now the Top Level Talks were coming to take a decision, and the decision was that the Australians would accept their 24 aircraft and pay an extra $A1.365m each. The Prime Minister, John Gorton, said that, even though the fatigue problem had not been solved, the US government had agreed to 'replace at no cost for materials or labour' any box that could not be guaranteed for a 15-year life 'at the appropriate time and at no increase in the ceiling price formula'. Just what the last bit meant was unclear, because the original $90,749,040 had been a 'ceiling price' back in 1963. At the same time, the bill for the conversion of six aircraft to the reconnaissance configuration was given as $A30.6m which seemed a bit of a jump from $A7.98m. Labor opposition deputy leader, Lance Barnard, said that if his party was returned at the October 1969 General Election it would seek to renegotiate the deal and buy a 'cheaper, more suitable' alternative.

While the politicians shouted in Canberra, in November 1969 the aircrew at Amberley were delighted to receive their $A4.5m F-111C simulator, made by General Precision/Link at Binghamton, New York, where some RAAF personnel had spent two years. A heavy responsibility lay upon Sqn Ldr B. A. Johnson, OC Simulator, and Flt Lt Tom Carlyon, OC Simulator Maintenance, in keeping the great installation fully and correctly employed so far from the manufacturer and in such a completely adverse political environment. In November 1969 no F-111C had arrived at Amberley and none seemed imminent, whereas the training programme for the base had been planned on flight operations from July 1968. The only Aussie with plenty of F-111 flying in his log book was Flt Lt Ian Westmore, who in 1968-69 had logged over 400 hours with the USAF on exchange posting. In fact, the first team of 50 pilots and navigators had



*Above:* Then CO of the F-111C force, Gp Capt (now Air Commodore) 'Jake' Newham is seen leaving his aircraft in October 1973 after saluting HM The Queen and the Sydney Opera House opening ceremony. / *RAAF*

*Left:* Wg Cdr Geoff Talbot, then CO of 1 Sqn, taxies on to the flight-line at RAAF Butterworth, Malaysia, leading a six-plane contingent to the Five-Power Integrated Air-Defence System. This 1974 trip was the first outside Australia by the F-111C. / *RAAF*

*Right:* Every RAAF crew flies occasionally to Mach 2.2 at high altitude in the 72.5° configuration and with clean wings. / *RAAF*

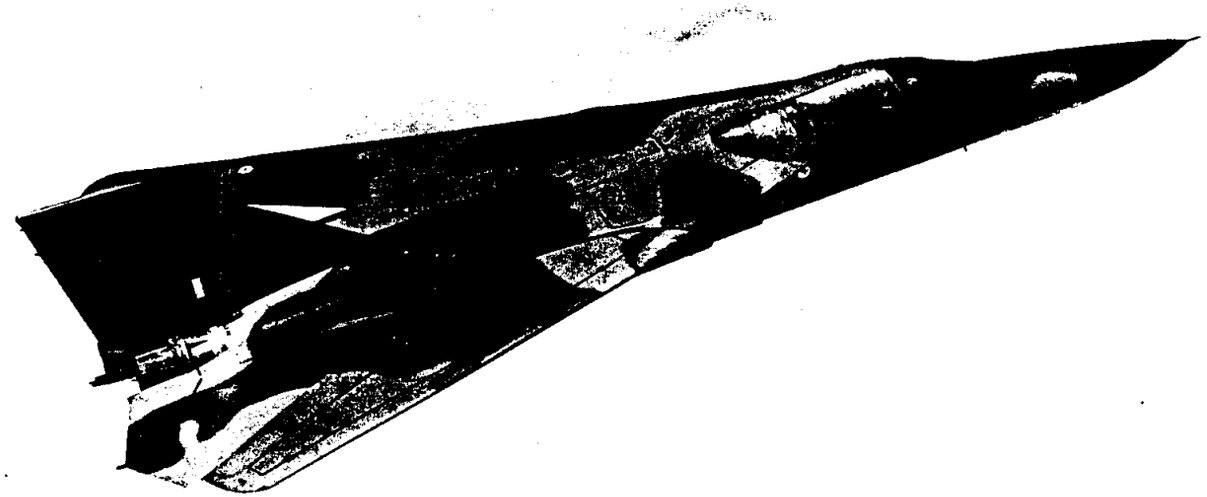


begun training on the F-111A at Nellis in March 1969, but had had to break off and go home when the first wing box cracked in fatigue testing.

On 23 September 1969 Prime Minister Gorton said that the RAAF would wait for completion of the testing of the revised wing box, which was scheduled to start on 9 October and be completed by 16 November. But an extraordinary series of problems and delays held back the completion of USAF testing until late May 1970. Further long talks ensued, and after conferring with Dr John L. McLucas, Deputy Secretary of the USAF, Defence Minister Malcolm Fraser said he had requested the USAF to 'reactivate the F-111C force as soon as possible so that the aircraft can be delivered'. Fraser said that to delay until mid-November 1970 — the earliest date for delivery following analysis of the testing of the new box — would 'involve a major disruption of the RAAF's programme for flying training'. In any case, he added, the USAF had no plan to rebuild the wing boxes of its F-111A fleet, but would incorporate modifications only on an IRAN (Inspect and Repair As Necessary) basis from 1972 onwards. So at last it was 'all systems go', and the chaps at Amberley eagerly looked forward to getting into the air. The ferry crews left Australia in December 1969, some for the third time.

It was just before Christmas 1969 that a Nellis F-111A had a wing come off, resulting in grounding of the whole F-111 inventory. Fraser issued a press release that was hardly coherent — 'All aspects of the matter will be canvassed ... The purpose of the visit is to canvass the possibilities concerning the F-111C' — and for the first time mentioned 'alternatives to the present F-111C'. (Indeed at this time the US Secretary of Defense, Melvin Laird, himself said 'If we are going to be plagued with a continuation of these problems we must explore other alternatives'.) So in April 1970 Fraser was talking to the Americans (again), accompanied by the new CAS Air Marshal Colin Hannah; the new Defence Department Secretary, Sir Arthur Tangey; and (for about the 19th time) Air Vice-Marshal Hey. The upshot was that Fraser reported 'The F-111C is at the moment quite unacceptable to Australia and to the RAAF'. The hastily reassembled aircraft were equally hastily re-dismantled and put back into long-term storage. For the first time Australia secured a right to cancel without losing the whole of its F-111 investment, which at that time (without one aircraft delivered) was $A227m. Provided the F-111 was still in the US inventory and the deal was agreed by the US Congress, Australia could cancel and sell the F-111Cs back to the US for a price between $A120m and $A140m. Thus, immediate cancellation would result in a reduced loss of about $A107m (US$86.7m), this sum rising week by week from May 1970 onwards.

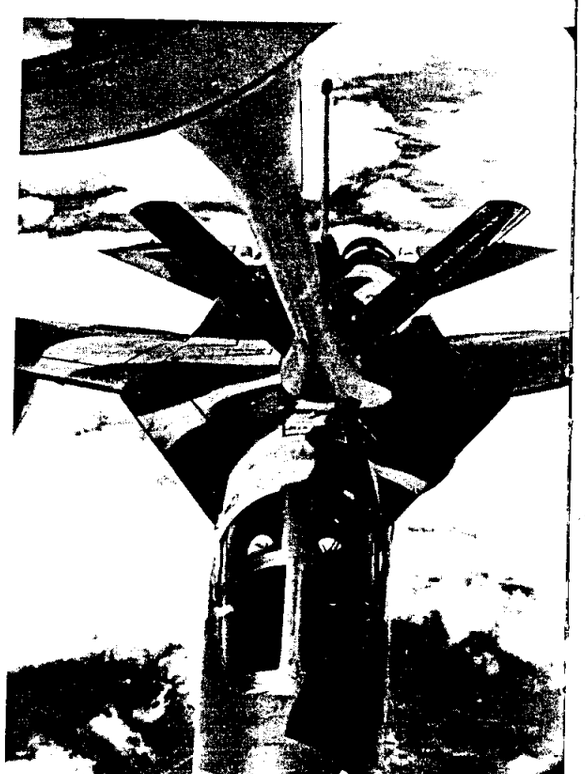
Meanwhile, to give the RAAF something to fly, 24 F-4E Phantoms were leased from the US Government at a price of US$35m for two years and US$12m a year thereafter. All 24 were flown to Amberley in 1970, and if the F-111C had been finally cancelled a further 16 would have been bought or leased plus eight RF-4E reconnaissance aircraft and flight-refuelling Buddy packs. The Phantoms gave the Aussies experience of a fairly modern aircraft with all-weather



capability, and took the pressure off the F-111 troubles. In fact the versatile fighter-bomber proved so popular in the RAAF that a strong cell grew up that resisted sending the 23 survivors (one was lost off the Queensland coast) back when the time came.

In December 1970 Opposition leader Gough Whitlam stung Fraser into saying 'Mr Whitlam's call for a decision on the F-111 ignores the facts... In April this year I negotiated with the US Secretary of Defense safeguards that were not present in the original agreement: the F-111C must meet RAAF operational and technical requirements; the US will buy them back if they do not; and we need not make a decision until static and fatigue testing is completed late next year...' But Lance Barnard attacked the government for the open-ended and 'willy nilly' nature of the original contract, which gave Australia no safeguards of any kind. The theme was even taken up by Fraser himself when he blamed his own Liberal-Country predecessors, Menzies and Townley, for the terms of the agreement.

While all this heat was being generated, the F-111C programme quietly continued, with no announcement that the aircraft would, after all, be delivered. Each aircraft was virtually rebuilt, with 240 chief modifications including completely new wing boxes. The USAF had required one of its own new F-111A



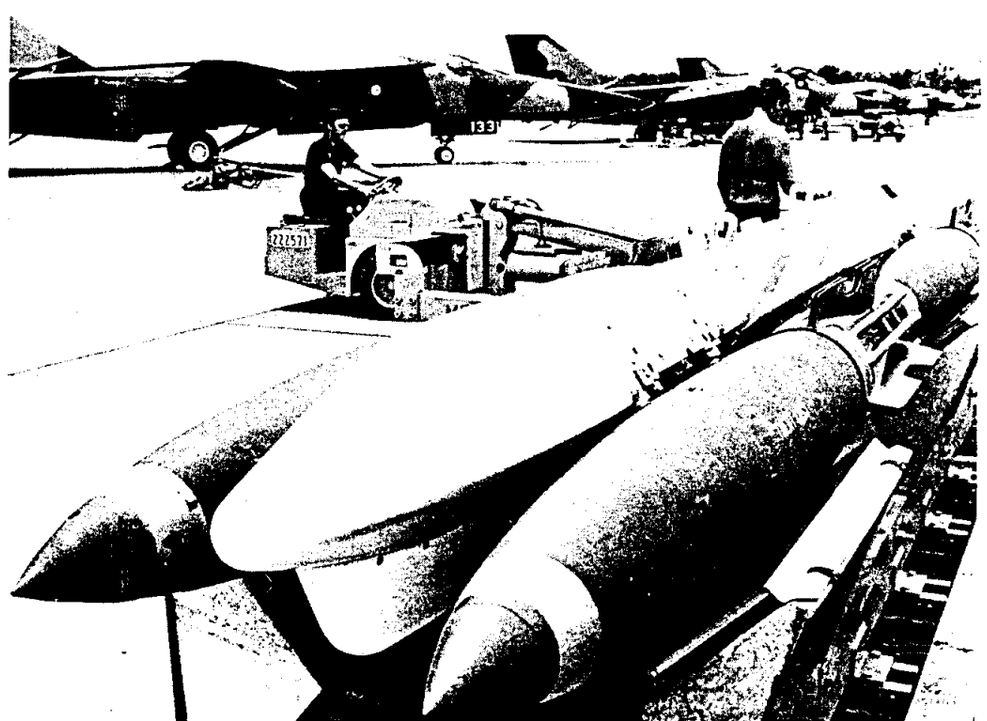


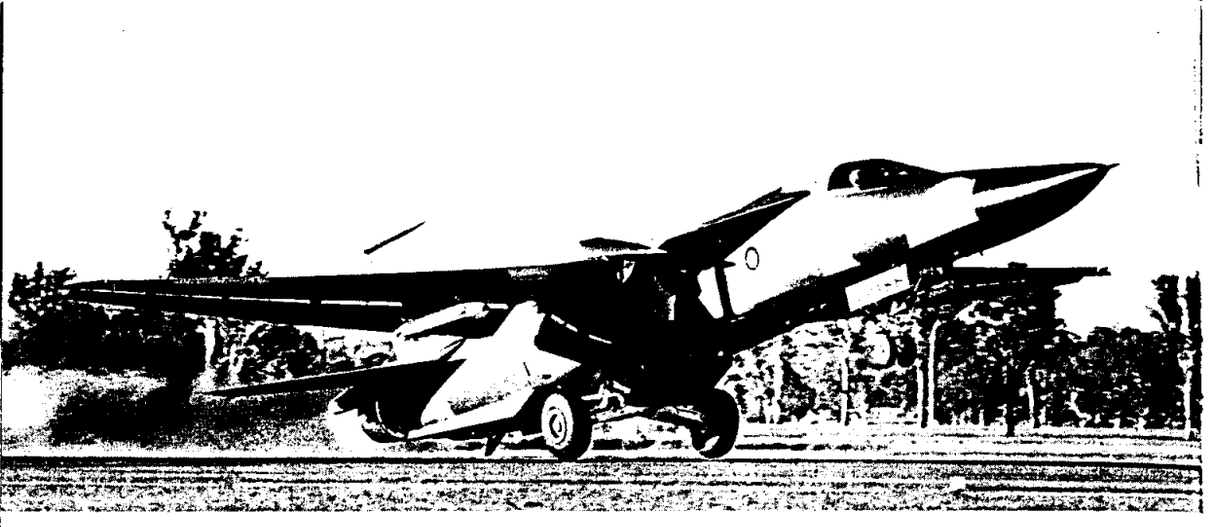
*Left:* The arrival at Amberley of two USAF KC-135 Stratotankers in October 1976 enabled crews to practise in-flight refuelling during Exercise Kangaroo II. This picture was taken by the right-seater of the next F-111C in the queue. / *RAAF*

*Bottom left:* This is how an F-111C looks to the USAF boom operator. The receptacle is immediately behind the crew escape module. Pilot of the F-111 on this occasion was Grp Capt (now Air Commodore) Bill Collings, Air Staff Officer at Amberley. / *RAAF*

*Right:* Armourers of Amberley's No 482 Maintenance Sqn, Leading Aircraftmen Jim MacAnally (driving) and Ken Lawrence (steadying the 500lb retarded bomb) sweat to load 24 bombs aboard each of four aircraft for a firepower demo at the Joint Services Staff College held at Puckapunyal bombing range in Victoria. Mixed in with the load were lo-drag bombs without the tail airbrakes. / *RAAF*

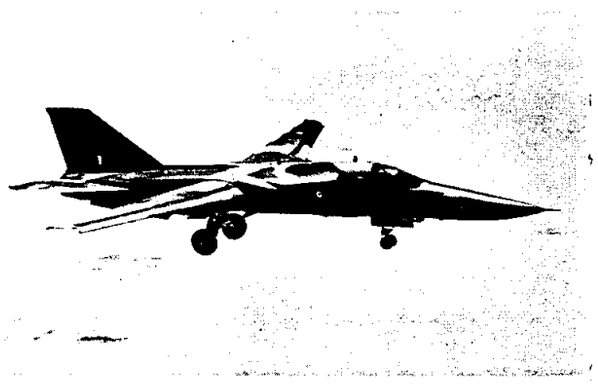
*Below:* A normal load for a C is four of these pylons each carrying six bombs (in this case retarded 500-pounders). The bomb bay usually carries extra fuel. / *RAAF*





wings, complete from tip to tip, to be fatigue tested to an equivalent of 40,000 hours. The RAAF had asked for only 24,000, but in early 1973 an F-111C wing, after rebuild, was tested to 32,000 hours. In January 1973 a party of 12 aircrew flew to the United States to resume training after a gap of almost four years, followed by further teams in March and May. On 14 March 1973 Barnard, by now Defence Minister in Whitlam's new Labor government, announced how appalled he had been by the 'ineptitude and indecision' of his predecessors, but concluded he had 'no legal or economic alternative other than to see out the contract'. (This was ill-advised; there was no justification for destroying public confidence in the nation's main military aircraft merely to discredit political rivals.) Total cost was then put at US$324m, of which $236m had been spent, and negotiations were started to try to lop $30m of even that total (but in fact it continued to rise, to cover further modifications and provide continuing support). And on 15 March the Qantas shops at Sydney at last began to work on Litton inertial hardware five years after the airline constructed special facilities to handle the F-111 navigation system.

Finally 'F-111 Day' arrived on 1 June 1973. Almost everyone who was anybody in Australia seemed to be in front of Hangar 364 at Amberley to welcome in the first six aircraft, all fully crewed and led by Grp Capt 'Jake' Newham, CO of 82 Bomber Wing. They had been working up at Nellis for five months, and finally took four days (18 flight hours) to ferry from McClellan AFB via Hawaii (Hickam AFB) and Pago Pago AFB in American Samoa. Further sextets flew in, in July, September and December 1973 while the 23 Phantoms were reluctantly flown back to the USA in December 1972 and June 1973. The final six F-111Cs were delayed by shortage of fuel at Pago Pago, had to reposition at Fiji and finally arrived at





*Top left:* Heat haze from the afterburners of the 18,500lb P-3 engines blots out the trees as a C lifts off. / *RAAF*

*Centre left:* Like Aardvarks everywhere, 1 and 6 Sqns fly at night. Here the afterburners glow as a training mission departs Amberley into the dusk. / *RAAF*

*Bottom left:* In this high-lift configuration, with little fuel and no external load, this C-model could fly comfortably at 100 knots. An aircraft with fixed highly-swept or delta wing would have its nose high in the air. / *RAAF*

*Above:* Afterburner torching of dumped fuel has been used on spectacular fly-pasts by the RAAF to mark the opening of Brisbane's Warana Festival and Melbourne's Moomba Festival. / *RAAF*

Amberley in early December. The RAAF said they were a week late, but in fact they were more than five years late!

On 20 October 1973 nine aircraft from 1 and 6 Sqns, of 82 Wing, flew in formation over Sydney Opera House as the latter was opened by HM The Queen. At last the F-111C seemed to be in business, and this was just the start of a long, tough and thoroughly successful service career. The first major exercises were held in the Darwin area in February and March 1974, in the course of which 1 Sqn flew what I believe were the first sorties ever made by F-111s in the air intercept role; I should think they were also the last. Another notable mission was the 12½ hour flight round Australia via Darwin, Pearce, Edinburgh Field and Pt Cook on 8-9 April 1974, the 50th anniversary of the first such flight (by a Fairey IIID seaplane that took 44 days).

In December 1974 the RAAF awarded GD a contract worth about $280,000 for 'a feasibility study to determine the work required to modify four F-111s for the reconnaissance role.' Just what had been left out of the earlier USAF-funded $118m programme is hard to discover, but Mr Barnard appeared to start from Square 1 as though a reconnaissance F-111 was a new idea! In 1975 the CAS, Air Marshal Rowland, said that four RF aircraft was inadequate in time of serious conflict, but that having four conversions would at least provide a nucleus on which to build. In late 1977, three years after the GD contract, the reconnaissance pod was said to be 'still under development in the US'. Presumably it is not the same as the pod that was fully developed for the RF-111A ten years earlier at a cost of $118m. As the USAF never used these they ought to be going cheap.

In 1975 three C-models completed a three-week exercise off Hawaii with the US Navy. In 1976 two set speed records in high-altitude missions between major Australian cities, flying much further than the direct distances to keep beyond sonic-boom range over the sea; the times were: Adelaide/Melbourne, 27min 8sec, and Sydney/Melbourne 35min exactly, for a distance of almost 1,000km (621 miles). In 1977 intensive exercises were held in the Philippines. Back near Amberley on 28 April 1977, after nearly four years and 21,000 hours, the RAAF lost an aircraft when Capt W. H. 'Bill' Baker and Flt Lt David Clarkson rode back to earth in their capsule after their 6 Sqn machine suffered 'a massive explosion' in the engine compartment. Baker, a Vietnam F-111 veteran on exchange posting from the USAF, evened an old score because an Aussie pilot had written off one of the Nellis aircraft five years previously. The media reported the loss soberly, and noted that the RAAF had expected at 21,000 hours to have lost two aircraft and be half-way to No 3. This can fairly be taken to mean that the F-111C has arrived, won its spurs and been finally accepted as a good piece of kit — which, of course, it had been all along. To clinch this opinion, the Australians are getting an ex-USAF F-111 to fill the vacant slot on the 6 Sqn flight-line.

# Australia's F-111 update debate

As the RAAF looks at updating its F-111 fleet, **Mike Gaines** visits RAAF Amberley to examine the needs behind the programme.

Australia's location, perceived threats, and the limited amount of hardware available to counter them, dictate that the Royal Australian Air Force's operating philosophy be different to that of, say, the European air forces. The latter have the luxury of larger fleets of more varied types and their allies to help them, but Australia has none of these. Her allies are distant and any reinforcements would take a considerable time to arrive, given the politicking involved before the long-range reinforcement could even start.

In Europe a strike package could be set up with tankers, airborne early warning (AEW) jammers, air-defence suppression aircraft, and a fighter sweep to help the strike force aircraft penetrate to the target, hit it, and make good their escape. The RAAF does not have any tankers or AEW aircraft at present, although these force multipliers are at the top of the shopping list.

There are no dedicated combat-capable electronic warfare aircraft, no dedicated Sam killers, and the F-18 Hornets would be needed for air defence and so in short supply for escort missions. So the strike force, the F-111s, will have to handle their mission requirements alone, demanding true multi-role flexibility.

The Royal Australian Air Force's strike element consists of 22 General Dynamics F-111s, including four reconnaissance variants, based at RAAF Amberley, near Brisbane on the eastern seaboard. The F-111s are operated by 1 Sqn and 6 Sqn, which together comprise 82 Wing, the RAAF's strike element. 1 Sqn is the operational strike squadron, while 6 Sqn is operational but also handles F-111 type conversion, reconnaissance training, and operates the four RF-111As.

The RAAF F-111 is a hybrid combining the F-111A fuselage with an extended-span wing equal to that of the F-111F, but with the beefed-up gear, tyres, and brakes of the F-111K which was developed for the UK but eventually dropped. The four RF-111As are converted F-111As, again with the beefed up main gear and extended wingtips. Instead of the Pave Tack installation a reconnaissance pallet fits in the internal weapons bay, but the RF-111s can still deliver dumb weapons or toss laser-guided weapons for Pave Tack laser designator F-111Cs.

The F-111 force is at present awaiting the deliberations of a Defence Ministry sorely stretched by a tight budget. A decision in principle has been taken to update the F-111's avionics, but the actual details have yet to be worked out. It makes sense to fit the RAAF F-111s to the same standard and with the same equipment as the US Air Force's F-111s, but the RAAF is realistic enough to realise that this might not be affordable. However, the Service wants the F-111s to

**Above** *An RAAF F-111C shows its Pave Tack laser bombing module*

remain an effective force until at least 2010, so some updates are essential to keep the weapon system able to cope with future perceived threats.

The Australian Defence Ministry has already allocated A$160 million to the two-year F-111 Pave Tack incorporation programme. Upgrading the avionics will, it is estimated, cost another A$240 million. A bone of contention between the politicians and senior RAAF officers is that funds have not been made available to equip the F-111s with the data pod needed to enable use of the GBU-15 advanced laser-guided bomb. This system, which is a natural follow-on to the current weapons used, has been evaluated by the RAAF, and its purchase has been planned but still awaits ratification by the Defence Ministry.

## Analogue

The RAAF's biggest F-111 problem is that the aircraft have 1960s-vintage analogue electronics systems. These are quite accurate, but by present standards are slow to use, and user unfriendly. Worse, they are bulky and heavy and require lots of cooling air. Their serviceability is not as good as that of digital equipment, and they are difficult to work on. Any new systems retrofitted to the aircraft, such as the Pave Tack laser bombing system, are themselves digital and therefore need a tailormade analogue/digital converter interface which needs even more space and cooling.

The main thrust of the F-111 update will be to change the analogue navigation and weapons aiming system for a digital system, and at the same time replace the analogue flight control system computers with a digital system, tying in the whole with a 1553B digital databus. This would then considerably ease the introduction of digital-based weapons systems such as the GBU-15 and its data transfer pod.

The roles and weaponry of 82 Wing reflect the total role flexibility required of the F-111s. The primary job is long-range unrefuelled conventional strike against high-value land targets such as enemy communications, headquarters, airfields, and econo-strategic targets such as refineries. The F-111Cs are equipped with the Pave Tack infrared search and track/laser designator pod. A secondary role is maritime strike and third is battlefield interdiction.

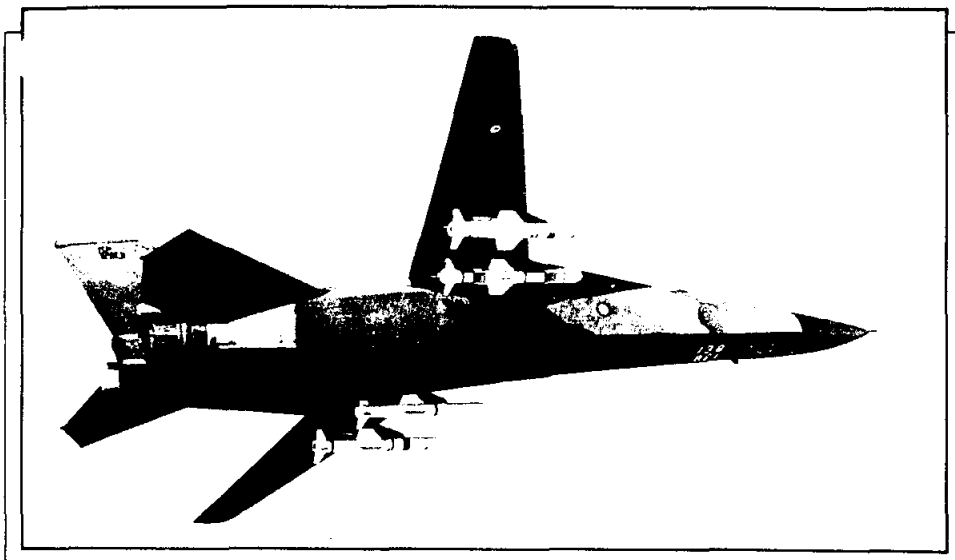
## Weaponry

The F-111's current weapons suite includes the Mk.82 500lb HE iron bomb, which can be dropped either slick or in high-drag configuration, and the Mk.84 2,000lb HE bomb. With a flying tail and laser-seeking head fitted the Mk.84 becomes a GBU-10 and the Mk.82 is transformed into GBU-12. Both LGBs are part of the Paveway II family. The Rockwell GBU-15(V) uses the dumb body and 2,000lb HE warhead of the Mk.84, but allied to a larger cruciform wing which increases manœuvrability at low level and increases the bomb's range. The GBU-15 uses electro-optical guidance. A camera in the weapon's nose transmits a TV (daylight only) or imaging infrared (IIR) picture to the launch aircraft, and the navigator flies the weapon on to the target.

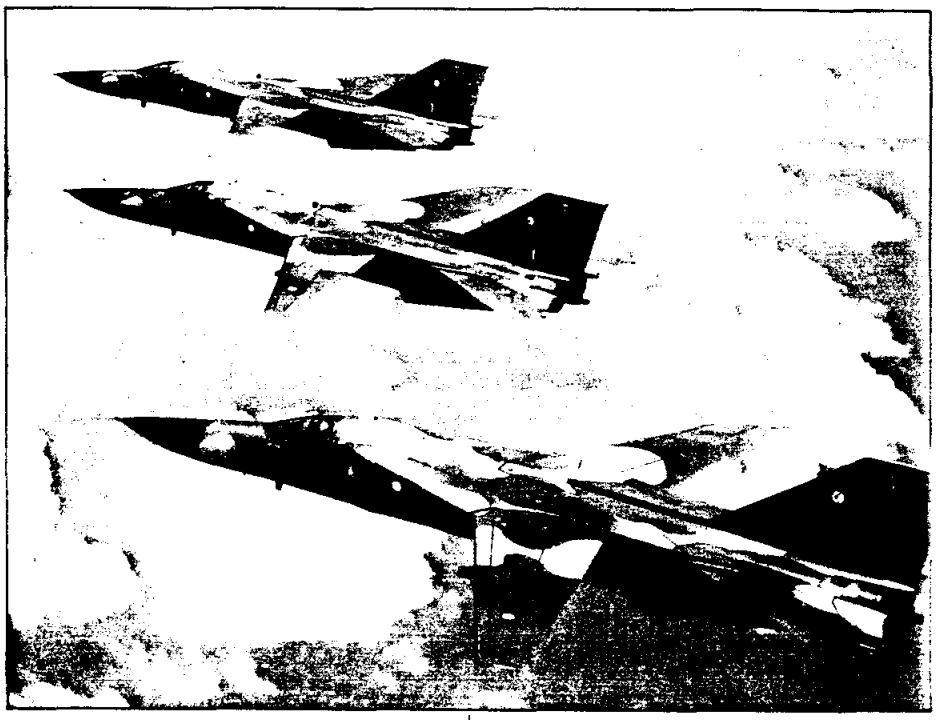
With GBU-15's extended range the aircraft must carry a datalink pod to receive the bomb's view and transmit flight commands to the weapon. GBU-15 is a logical and simple extension to the F-111's capability, but financing has not yet been found to fit it to the F-111 fleet. The F-111C could carry up to four GBU-15s plus the datalink pod. For the GBU-10/12, target identification and designation is with the Pave Tack module which is stowed semi-internally, replacing the General Electric M61A1 Vulcan 20mm Gatling-type cannon.

The latest weapon to join the F-111 inventory is the McDonnell Douglas AGM-84A Harpoon anti-ship missile; the F-111 can carry four of these. The Harpoons, purchased for the maritime strike role, are Block 1C-model missiles. This variant has extended range, and can be programmed with a number of waypoints, pop-ups, and pop-downs *en route* to its target. These features are employed to mask the direction from which the attack originated and to confuse the target ship's defensive systems.

**Above** *Part of Amberley's flight line.* **Right** *The F-111 weapons suite; the 20mm cannon can replace the Pave Tack module, or* vice versa



**Above** *An F-111C with four Harpoon anti-ship missiles.* **Below** *F-111 crews will get only 20hr a month training, reducing role proficiency*



The RAAF F-111C is claimed to be the only aircraft in service able to make full use of all of these Harpoon 1C features. The US Navy's updated Viking, the S-3B, will be the next to use it in service.

The F-111C's third role is battlefield interdiction, although the tactical economics of using such a large, expensive, and relatively unagile aircraft over a battlefield are questionable. The aircraft can carry up to 24 500lb bombs on pylon-mounted multiple ejector racks, or the Australian Kuringa cluster bomb. Pop and dive attacks are practised, although a high-speed low-level retarded lay-down or toss would be more survivable if circumstances permitted.

If the RAAF concept is to go for "aircraft packaging", rather than strike packages to ensure penetration to target, there are other areas of the F-111 that need to be brought up to date. The present suite of penetration aids, electronic countermeasures pod, chaff, and flares needs to be modernised. Also, the RAAF F-111 does not have any form of anti-radar missile and only an early-generation air-to-air missile for self-defence.

The current penaids are the ALR-62 radar homing and warning receiver, which the crews describe as "OK", and the ALQ-94 electronic countermeasures pod, which needs replacing by an electronically more extensive, faster, and more agile jammer pod. The chaff and flares are disposables, and can easily be improved on as necessary.

As for defensive weapons, the Vulcan cannon have been replaced either by Pave Tack or by the reconnaissance pallet. Although the aircraft have AIM-9 Sidewinders, these are the limited-aspect "B" models. "We want to put AIM-9Ls on a shoulder-pylon installation so we keep the pylons free for offensive weapons, but the flaps get in the way, so we are looking for another method at present," says Flt Lt Trevor "Boomer" Taylor, an F-111 instructor. "Of course, our job is to penetrate and put the bombs on the target, not mix it with fighters. We do not want to get into a fight. Our tactics are not to be seen, but, if we are, to go like hell and leave the threat behind."

## Tankers?

The primary method of F-111 evasion, very low and very fast, uses a lot of fuel (up to 128,000lb/hr in full afterburner), and without a tanker force, fuel regains the magical aura of pre-tanker days in other air forces. The F-111s can carry 600gal drop tanks, one each on up to six stations, including the fixed pylons. In practice they carry one each on stations 2 and 7, which do not swivel as the wing sweeps. These pylons are toed-in from the chord line, so they are streamlined at 26° wing sweep. The fuel from them is used first and then they are ditched, allowing the wing to be swept further back for higher speed.

The RAAF is having four VIP Boeing 707s converted to tanker configuration by Israel Aircraft Industries, but these will be drogue-equipped and so will only be able to tank the probe-equipped F-18 Hornets. The F-111 is a female receiver, and in its present configuration can only take fuel from a boom-equipped tanker such as the US Air Force KC-135 or KC-10. The Australians could fit a boom-and-drogue configuration, or a bolt-on probe, but this then puts the scheme into the loony world of politics. Tanking the defensive F-18s is OK, but tanking the offensive F-111s is not, apparently.

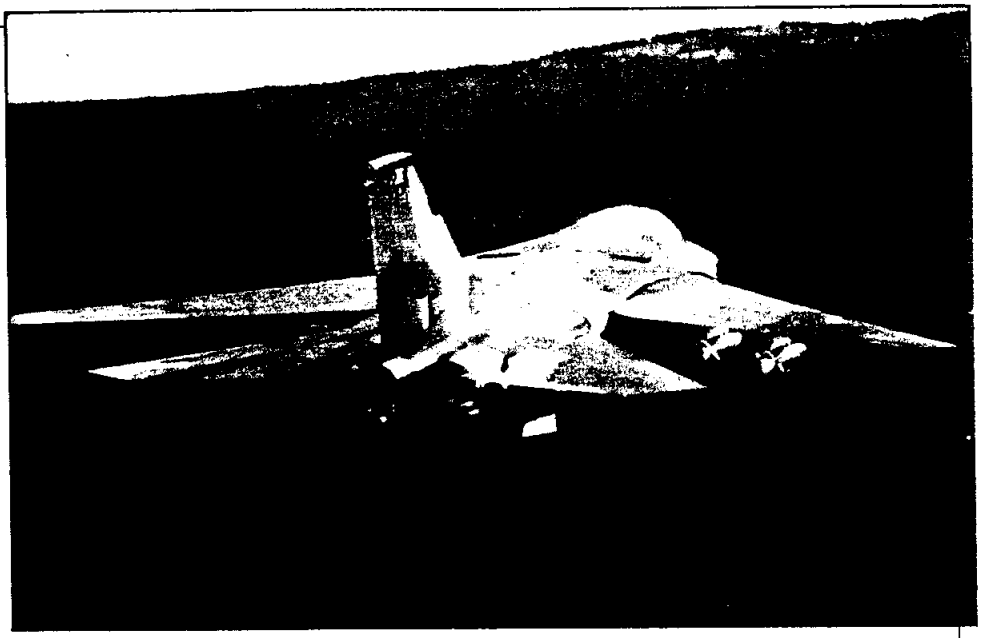
It might also make sense to pass on the RF-111As' reconnaissance role to the F-18 Hornets. These, with the 707 tankers, would have the range for strategic reconnaissance, freeing four airframes for modification to F-111C status with Pave Tack.

The core of experience in the RF-111As is dwindling fast. This is allied in part to the continuing exodus of experienced RAAF pilots to more lucrative jobs with the airlines, and partly to the continuing cutbacks in flying hours for the RAAF in general.

In the next financial year the F-111 fleet's flying time is to be cut by ten per cent to save money. With individuals flying only about 20hr a month it will be difficult to maintain crew currency on type, let alone in role. Passing on the reconnaissance role to the F-18 would therefore improve role proficiency by concentrating valuable training hours on the strike mission only.

As industry vies for the F-111 avionics update contracts, the Defence Ministry might take more heed of the aircrew. The updated F-111 will be a potent weapon well into the next century, but it will be of little use if the aircrew are not given the means of practising its use.

# The F-111 from the cockpit



*The "Pig" in its element—low and fast*

The RAAF aircrew call the F-111 "The Pig", not because of any adverse handling characteristics, but because it has a long snout which spends a lot of its time snuffling along close to the ground. The first thing I note on climbing into the F-111 is the view over the long nose, which sticks out way ahead of a very deep instrument coaming. The bottom edge of the curved windshield is about two yards ahead of me, so the view down and ahead is cut off. As F-111 instructor Flt Lt "Boomer" Taylor explains, "That's no problem with Pave Tack, the nav can look ahead on that, but with this [an RF-111B] we have a closed-circuit TV camera just aft of the nosegear so we can line up on the target. At high level the nose blocks the view of the ground ahead for about 20 n.m."

As we taxi out, I put our target co-ordinates into the archaic INS, which is a real pain to use. Boomer reads out the lats and longs. "OK, that's North 48 . . . ," I say. "No, mate, *South*. We don't have that much fuel," says Boomer. Red-faced, I crank in the numbers. You twist a spring-loaded knob, and the co-ordinate numerals click round on their drums. The harder you twist, the faster they go. Twist one way to increase, the other way to decrease. The system can store three destinations, to use as waypoints. It is time consuming and laborious enough to do while taxiing; later I'll find what a pain it can be.

We pull up into a max angle climb from the runway at 9 Alpha and 190kt. Boomer eases the wings back to 26° as we swing east to overfly Brisbane at 15,000ft, checking out the automatic terrain following (ATF) systems. We obtain clearance into the supersonic low-level corridor as we complete the checks with 200ft on the Set Clearance Plane and select "Hard" on the "Soft/Medium/Hard" ride selector. The last check is to see that the failsafe auto-pull-up works. Any faults in the ATF chain and the aircraft will pull up at 3*g*.

## Terrain following

"OK, all ready? Let's go down," says Boomer, engaging the ATF and pulling the wing back. The nose pitches down, hesitates, and pitches down again, Boomer is sitting with his hands on his knees as we descend rapidly. At 1,000ft the nose starts pitching up, giving us 2*g* until we are straight and level at 200ft. "Now watch this." The noise levers go forward and the wing sweeps even further back as the afterburners kick in. The sea rushes past, and as we go supersonic there is just the slightest tremor. Boomer hand-flies us down to 100ft and Mach 1·2. The sensation of speed is fantastic.

I look in the mirror: behind us a ball of spray erupts from the sea where our shock wave hits. But what really sticks in my mind are the fuel flow gauges. In full afterburner the left engine drinks 52,500lb/hr and the right 62,500lb/hr, with the turbine inlet temperatures hovering around 1,100°C. Taking a glove off, I note that the canopy is getting hot to the touch. We maintain this dash for a minute or so before pulling up and slowing down to a pedestrian 200ft/540kt.

## Auto-toss

We carry out a laydown attack on Snapper Point range, then swing around south for a 270° turn to head north for a Pave Tack auto-toss profile demonstration. After the 3*g* pull-up and release Boomer racks it round in a 4*g* manœuvre designed to allow the Pave Tack to continue lazing the target as we escape at low level back to the south. "Now let's update the nav kit," he says, reeling off a string of numbers for me to tweak into the "Present Position" number cruncher.

This is not so easy, because Boomer is pulling us hard round to cross over the centre target on the range, whose co-ordinates I am desperately trying to feed while fighting the *g*, avoiding the stick, and trying to keep my head up. It really is a pain compared with the modern systems I have used before. I get the numbers in and press the "Fix" button as we cross the target. The kit declines to accept it, so we turn hard and overfly again. This time it goes in, and the INS is updated.

We head inland towards the Great Dividing Range for some low flying. The terrain-following radar has a narrow beam width, so in Auto TF the aircraft often passes extremely close to high terrain on either side. Auto TF is usually a night/bad weather option. In daylight the pilots prefer to fly the TF, following pitch demand bars on the AHI and keeping an eye out ahead. Using the AHI will give the lowest terrain clearance (set in multiples of 200ft) for the ride quality selected: soft, medium, or hard. We select 200ft, hard ride, and bat along at Mach 0·9.

There are no problems with that, so we decide to do Auto TF. The system takes over, and Boomer sits back with his hands on his knees. "Pretty good, eh?" I am watching a hill dead ahead. "What? Oh . . . er . . . yes." The Auto TF pulls us up and, as we start to clear the ridge, pushes us down again. In hard ride it is a −*g* push which lasts for several seconds and is absolutely delightful.

Approaching the next ridge Boomer removes a glove. As we unload to 0*g* again he tosses it in the air, where it floats gently backwards until the *g* comes back on to position us in a valley. "In hard ride the system leaves it later for the pull-up, to keep your exposure time down as you cross the ridge. At night I would monitor the E-Scope TF presentation and the nav looks at his attack radar display for terrain avoidance in azimuth. Look how close we pass to this feature ahead and you will see what I mean about the narrow TF beamwidth." A small mountain slides past *very* close. "Good thing about night flying, you don't see them," laughs Boomer, "but we would like a moving map display so we can better plan our terrain avoidance, I doubt if we will get it, though."

## Reducing the workload

After ten minutes, I am totally confident in the Auto TF and feel at ease. We are chatting unconcernedly about what we are going to do next, and we are also free to keep an excellent lookout all round. In short, the Auto TF leaves the crew free to think tactics and keep ahead of the game.

With a digital nav attack system the workload in the right-hand seat will be much lower, and the overall system accuracy will be much improved. Old the F-111 may be, but the digital update will rejuvenate it. ◼

P.T.O →

# MAINTENANCE FEEDBACK

ISSUED BY THE DIRECTORATE OF AIR FORCE SAFETY No 2/91

## COCKPIT FOD

During strapping–in procedures in a PC–9 recently, a nut was found to be missing from the quick release fitting (QRF) fitted to the front seat. A cockpit search for the missing nut was conducted and it was subsequently found in the seat pan of the front ejection seat.

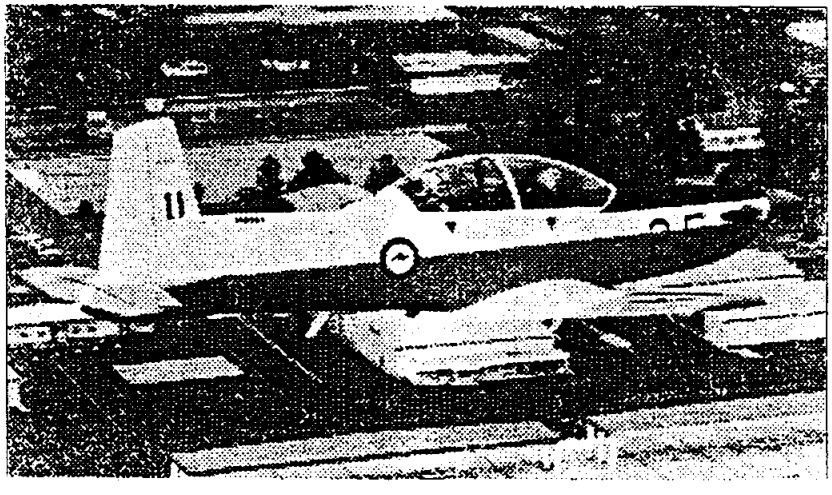
An examination of the QRF attachment nut and bolt revealed that the nut was serviceable and could be hand tightened onto the bolt a maximum of three turns before the locking function of the nut took effect. Further tightening of the nut required the use of a spanner to reach the required torque.

A new locknut and bolt were installed and the QRF returned to service.

The probable cause of this incident was that the nut to the QRF attachment bolt was inadequately tensioned during servicing of the parachute assembly. As to when this occurred was not positively ascertained. Aircraft maintenance records suggested that the most recent scheduled servicing of the parachute assembly had occurred at a contractor's facility at another base.

The seemingly harmless nut involved in this incident had the potential to cause a malfunction of the ejection seat had it been required. It could also have interfered with cockpit flying and/or engine controls.

This incident highlights the need for extra vigilance when conducting egress system inspections, servicing or maintenance, or involved in before flight or strapping–in procedures.



## Power poles apart

"You get used to everything, even hanging" is a proverb that is eminently applicable to our electricity supply system. According to your article on the downturn in what were once Australia's trendiest shopping centres (B, June 25), High Street in Armadale has been lined with renovated, upmarket shops – something that must have been a complete waste of time, as your photo illustrated.

Efforts to improve and enhance the appearance of our cities by private citizenry, business and public authorities alike are absolutely futile as long as electricity authorities keep abusing our visual environment. I do not believe the argument that to put local power supplies underground is more costly to such an extent that it is prohibitive. I rather think it is due to a lack of will to break with "we have always done it that way". And why did they get away with it? Because we have grown used to this ugly sight!

It is high time that we took notice of the insight of the late Robin Boyd (author of *The Australian Ugliness*) who, as early as the '60s, tried to extricate us from these webs of wire and forests of posts. It is high time we put real pressure on these vandals of our visual environment, to change their ways.

*E. SILVER*
*Townsville Qld*

## Feathering the farmers' nest

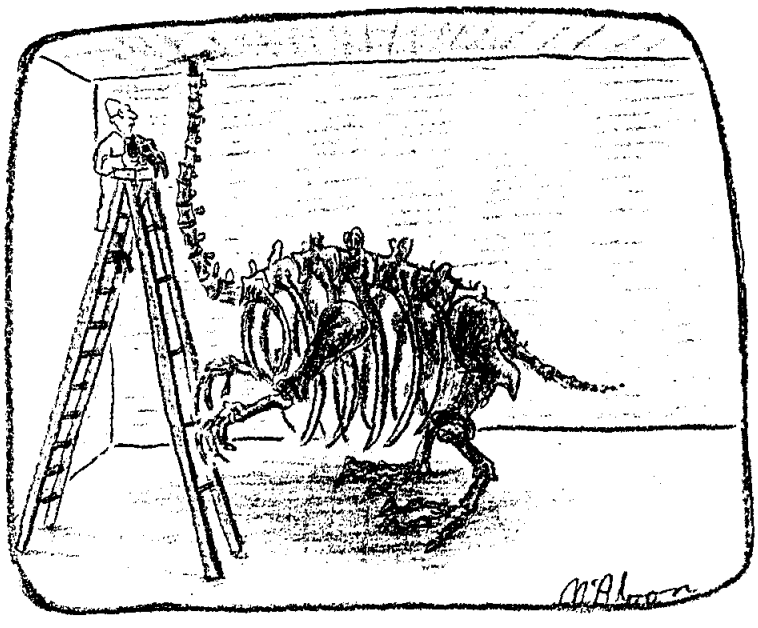
In reading the article on bird smuggling (B, June 4), I wonder why there hasn't been an attempt to hit smugglers where it hurts the most – namely, by lowering the market value of their quarry.

Some of the species being smuggled out of this country, especially galahs and sulphur-crested cockatoos, exist in large numbers – so much so that, in some cases where they have become pests, farmers have resorted to shooting and poisoning them.

Surely it would make sense to establish a legal export industry for these birds, thus allowing farmers an extra source of income and cutting much of the profit incentive out of the black market? Most importantly, it would ensure that the handling of the birds would be carried out in as humane a way as possible.

*B. R. SWAIN*
*Katherine NT*





## A politician, not a political scientist

Barry Cohen (B, June 25), in his defence of John Cain's appointment as an associate professor at the University of Melbourne, shows astonishing ignorance about the academic discipline of political science. Is he really a graduate? Politicians may be qualified to comment on the mean little squabbles and subsequent decisions of parliament, perhaps also on the machinery of government, but it does not follow that they are qualified to lecture in political science.

As every undergraduate knows, parliament and government are a relatively small part of the discipline we know as political science. It takes as its subject the distribution of power in a society and conflict over that distribution. There are other definitions, of course, but nearly all of them include the focus upon people in society. Politicians seem to know precious little about that.

*R. J. M. MIERS*
*Eltham Vic*

## F-111Cs 'non-supportable'

"Almost a Tiger" (B, June 18) brings to mind a number of issues not covered by Air Marshal David Evans (retired). Funding being finite and limited, it would appear to be prudent to withdraw the F-111Cs totally and not spend $400 million on updates as this aircraft is being phased out of the United States Air Force and therefore, within five years, the RAAF aircraft would be non-supportable. The money saved could be used to make the FA-18 Hornets fully combat-ready for air and ground operations and the provision of affordable airborne early-warning (AEW) aircraft such as the Hawkeye. Evans' article seems to believe in extra dollars being available from government which is totally unrealistic in the present economic circumstances.

*A. GAMKRCLIDZC*
*Lindfield NSW*

## There is no 'McLachlan' plan

I wish to take issue with Angus Mackenzie's article "Libs pull the wheels off the car plan" (B, June 18) which presents a highly misleading interpretation of the coalition's preferred approach to reductions in protection for the Australian car industry.

Now that the government's post-1992 arrangements for the car industry are in place, I have given a guarantee to the car companies that structural reform will accompany any acceleration to the government's proposed reductions in protection. These reforms have already been identified by the car companies themselves as major impediments to an efficient industry.

These reforms will be implemented early in the life of the next coalition government and will be patently working for the industry and everyone else including their suppliers, thus allowing time to adjust to lower levels of assistance. I have told them it would be unreasonable and unfair to do otherwise. This is in stark contrast to the government which proposes to cut tariffs without any commitment to address structural inefficiencies.

The car companies themselves have said that without such reforms – such as in the transport sector, industrial relations and introduction of a comprehensive good and services tax – the industry will never be competitive whatever the level of tariff protection.

# Almost a tiger

*The RAAF has lots of superb aircraft but the ability to use them effectively is dangerously hampered by the lack of support facilities. DAVID EVANS* explains why*

In 1937, the perceptive future prime minister John Curtin observed that air power should form the basic strategy for the defence of Australia. However, both before and since airmen have had little success in persuading governments – or, for that matter, the Navy or Army or Defence civilians – to that view.

The other services have been inherently reluctant to accept air power as anything more than a supplement to their own operations – some still doubt the need for an independent air force. On the civilian side, there is a dovish mentality that sees air power as too offensive, too provocative. The same timidity has resided in the minds of many politicians who prefer to look for softer options while beating their breasts about deterrence, self reliance and a host of other military terms of which they have only a superficial understanding.

JOHN HOULDSWORTH

David Evans: doves rule

One might expect that the blindingly clear evidence of air power as the dominant military factor in the Gulf War would bring an admission – however reluctantly – that perhaps there was indeed some substance in Curtin's observation. But no. The immediate reaction within the defence organisation was to warn against drawing conclusions from the Gulf War, to assert that the Gulf situation had little relevance to the defence of Australia. Defence Minister Senator Robert Ray made a similar observation when presenting his long-awaited and well-leaked defence review to federal parliament last month.

With this attitude, it is little wonder that the Royal Australian Air Force has developed only to the stage of being almost a tiger. It looks quite a formidable beast and this allows politicians and those who really disdain the use of offensive air power, even to defend their country, to conceal their squeamishness by pointing to the capabilities of the superb aircraft that make up the RAAF combat triad – the F-IIIC and RF-IIIC, the FA-18 and the PC-3 Orion.

However, the potential capability of the RAAF to pose a real deterrent is marred by denying it some key weapons that convert good aircraft into effective weapons systems; by so limiting the aircrews and support personnel that the force has almost no surge capability and would "run-out-of-puff" in a matter of weeks at high rates of effort.

One might start by making the simple but factual statement that the RAAF is incapable of effectively defending itself, or one single town or port in Australia, against air attack. It lacks the essential early-warning radars and the ground command and control environment to provide such defence. Therefore, no military asset within range of hostile aircraft is immune from pre-emptive strike and possible destruction before Australia's forces could undertake any initiative.

It is a sad fact that even in peace-time, today, there is no way of detecting aircraft flying into the north of Australia illegally. This disclosure has been made so often that repeating it is a nugatory exercise having no more than nuisance value. The government and Department of Defence are well aware of the situation and are obviously not concerned. The oft-repeated assertion that the matter is being addressed by the development of an over-the-horizon radar system is a palliative that manages to mislead the layperson into believing that this action will resolve the problem. It will not.

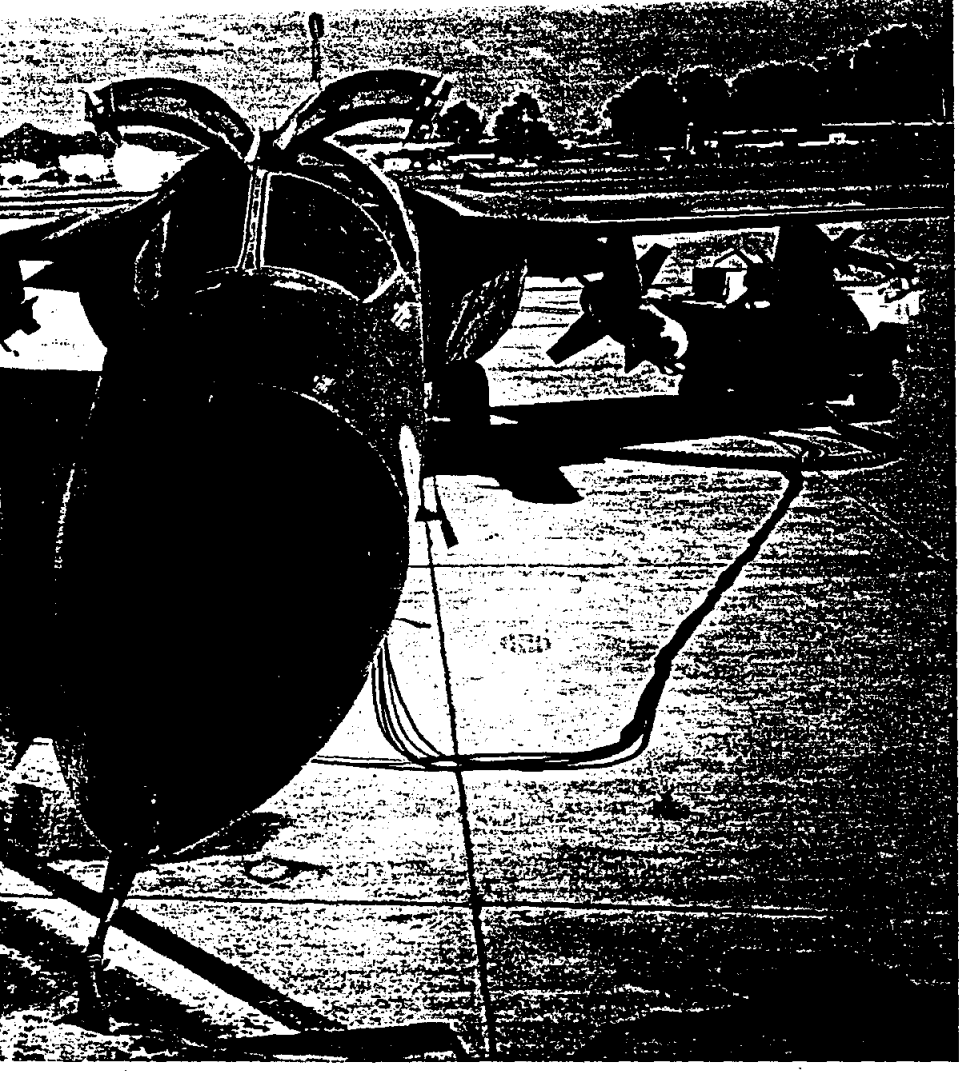
Jindalee, the two over-the-horizon radar (OTHR) systems being developed at a cost of near $1 billion, will not be in service before the turn of the century. OTHR has a number of well-known operational deficiencies and would not, without the addition of airborne early-warning (AEW) aircraft, enable the successful intercept of evading aircraft. In fact, the US Air Force, disappointed at the performance of OTHR, is disbanding the systems it has developed at great cost.

If one may take just a peek at the Gulf War – which the Defence department tells us could be misleading but does not say why – we see the extraordinary accuracy and effectiveness of cruise missiles. Then look at the aerial array of over-the-horizon radar. It stands about five metres high and stretches in a straight line for more than eight kilometres. One cruise missile and it simply will not work. Is it really invalid to look at the Gulf War and draw the conclusion that OTHR radars would be extremely vulnerable to cruise missiles and other long-range, precision missiles? To question the wisdom of spending $1 billion on two of these severely deficient and vulnerable systems? At least one must question the wisdom of affording them the priority OTHR enjoys.

One of the RAAF's F-111Cs: with little protectio

The acquisition of four or six of the proven AEW aircraft systems would immediately provide an effective air defence for at least some of the exposed areas of northern Australia. The later availability of Jindalee as a supplement would be an important force multiplier of the small AEW element. Its vulnerability would then not be a critical factor – but the program should be reviewed. In this way, a viable air defence system would be created. To claim that Jindalee could do so alone is simply untrue. Clearly, then, the priority is wrong. And, because this is so, Australia will be vulnerable to air attack and open to all who wish to fly into the country illegally until the AEW aircraft are acquired – around the turn of the century, according to the defence review.

*Air Marshal David Evans (retired) was Australia's chief of the air staff from 1982-1985*

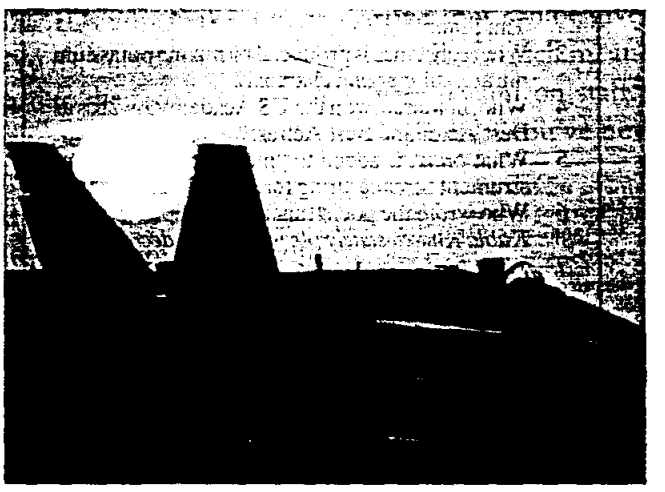


against enemy missiles they would have suffered heavy losses in the Gulf

The pity is that the FA-18 fighter, with its splendid radar, medium- and short-range air-to-air missiles, its excellent Gatling gun, could provide a very good air defence if supported by an effective early-warning system. It is ... almost capable.

The Strike Reconnaissance Force is equipped with one of the world's best strike aircraft and one of the best reconnaissance aircraft, the F-IIIC and the RF-IIIC. Even now, it is able to deliver its laser-guided weapons with the accuracy portrayed nightly on television screens during the Gulf War. It can launch deadly homing missiles at ships from a distance of 110km. However, it lacks the means of self-protection in a hostile environment. It does not have the electronic warfare pods to jam and confuse enemy defences such as radar-controlled anti-aircraft and surface-to-air missiles nor does it have anti-radiation missiles to home on enemy radar transmission and destroy the source. A missile such as the AGM-130 would also reduce vulnerability by allowing the F-IIIC to launch its weapons at a safe distance from the target. The F-IIIs of the USAF, armed with the full suite of protective devices, performed with extraordinary success in the Gulf War without the loss of a single aircraft. Doing the same job, the RAAF F-IIICs would very likely have suffered heavy losses.

To complete the deficiencies inhibiting Australia's most capable offensive weapon is the denial of tanker aircraft to provide air-to-air refuelling. There is the perception in some minds that extending the radius of action of the F-IIIC by the provision of in-flight refuelling would be seen as provocative by our neighbours. They fail to see, or do not want to see, that those same neighbours might be glad of the support of a capable Australian deterrent if they themselves were under threat. In any case, the perceptions of other countries is hardly a sensible basis on which to plan the defence of Australia. Equipped with a magnificent strike aircraft, a state-of-the-art target acquisition and guidance system and some precision guided weapons the RAAF's Strike Reconnaissance Force is ... almost capable.



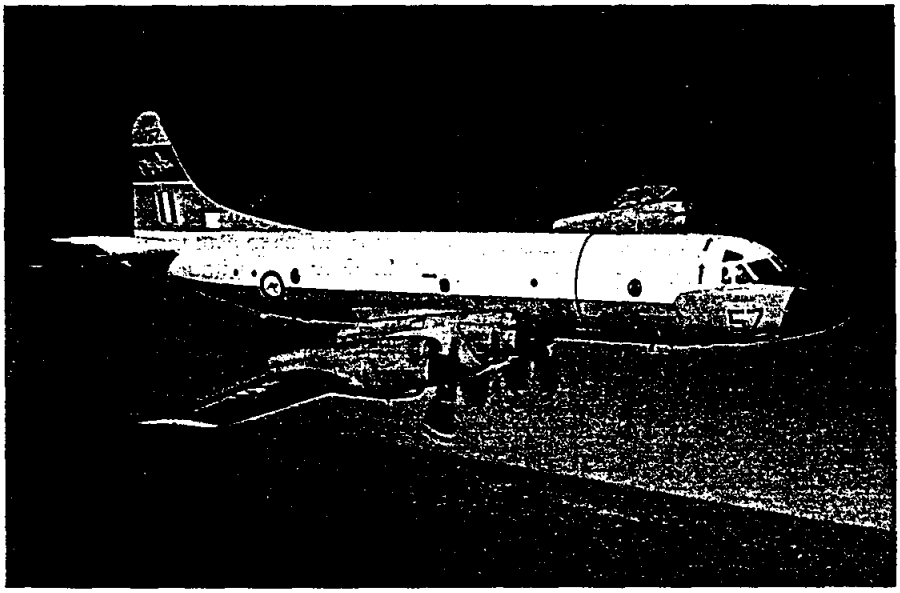
The FA-18 fighter: lacks an effective early-warning system

It is interesting that this aircraft, the most formidable weapon in our inventory and our main deterrent, owes its planned avionics update to civilian officers in the Department of Defence; it was opposed by the Army. One might reasonably assume that those same Army officers would have opposed the use of air power in the Gulf War, preferring instead to have fought the mother of all land battles. Such is self-interest.

Perhaps the nearest to being combat ready is the Long-Range Maritime Patrol element based at Edinburgh, South Australia. Equipped with the Lockheed P-3C aircraft, the LRMP force has an excellent surveillance, anti-ship and anti-submarine capability. Weapons include depth charges, homing torpedoes and the Harpoon anti-ship missile. Experience in exercises has shown the P-3C to be remarkably effective in all its allocated roles including anti-shipping. The ability of this aircraft to fly at more than 550km/h over substantial distances and to stay on station for extended periods marks it as a weapons system particularly suited to Australia's needs to cover vast areas with minimal resources.

The radar installation in the P-3C is of a past generation and denies the aircraft the full capability available from the latest version. New radars used in this long-range surveillance/reconnaissance role provide such remarkable detail as to allow ships to be identified up to 190km away. Senator Ray stated an intention in his presentation to parliament to upgrade the radar. One can only hope that this is not long delayed. Also, the cockpit itself is a generation behind; a factor that becomes important when it is realised that much of the P-3C's operations are carried out at night, at low level above the sea.

The P-3C is a good weapons system likely to play a big role in the defence of Australia and, because of the pre-eminent need for surveillance over vast areas, would be one of the first elements of the Australian Defence Force to be required. The need for a modern radar might therefore be seen to be pressing. It



**The P-3C Orion: effective weapons system but needs modern radar**

could be said to be combat ready, at the second level of performance.

The other greatly inhibiting factor is the lack of trained aircrews. The LRMP force would require at least 24 crews to meet operational commitments in times of tension or war. At present there are only 14. It takes at least two years to produce crews fully competent in the LRMP role.

The picture portrayed is of an RAAF with the potential to play a major role in our defence; to weaken a would-be aggressor to the extent that he could not mount a serious assault on this country and could not bridge the sea-air gap. The example of air power in the deserts of Iraq needs no elaboration. The same could apply to an enemy transiting the sea to Australia or to his base infrastructure, his command and control facilities. But as was also demonstrated in the Gulf War by the Iraqis, there is a great gap between potential and actual capability. The potential capability of the RAAF is certainly there but unless it is developed into actual capability by the acquisition of the weapons and support infrastructure essential to the allotted tasks, it will fail.

Without doubt, the clear priority of the Australian Defence Force is the provision of AEW aircraft to provide effective air defence. Without this there is not one town, city or defence facility that is within the range of hostile aircraft that could be protected. The farce that this is being addressed by the development of OTHR should be rejected. It ignores the repeated advice of Australia's senior airmen and could put the nation at risk should a threat, presently unforeseen, suddenly arise.

One might well ask why the federal government has ignored this advice over recent years. Why? Former defence minister Kim Beazley has stated in the clearest possible terms when referring to the role of AEW aircraft: "When you have it, you win. When you haven't got it, you lose." And yet he and his successor are prepared *not* to have it.

If our defence was genuinely the primary factor in the minds of those responsible for the development of the Australian Defence Force, different priorities for the acquisition of equipment would surely have been selected over these past half-dozen years. It is difficult to appreciate how a government can approve the construction of a dozen frigates at $500 million *each* while ignoring that our northern air approaches are wide open; that we are incapable of protecting our citizens against air attack. It is a great pity that AEW aircraft cannot be made in Australian shipyards – perhaps they would then gain approval.

The self-interest of the various groups charged with the development of our defence structure is best illustrated by the "warning" that we should not draw conclusions from the events of the Gulf War. Why not? It would seem to be eminently sensible for a country with a small population to do so.

Essentially, the failure to address priorities in a logical manner may be laid squarely on the rather absurd prediction of credible contingencies. What the analysts within Defence have put to successive governments is that a large-scale assault on Australia is extremely unlikely and, in any case, the development of such a capability by any nation within our region would be so obvious that we in Australia would have eight to 10 years warning of the event.

Instead, these analysts claim, we could be presented at much shorter notice with low-level assaults such as harassment of our ships or offshore oil/gas installations, the intrusion of hostile ships and aircraft into our territory or the landing of raiding parties. Those foolish enough to present this as the most likely situation in the foreseeable future are foolish enough to propose that Australia should react by countering these assaults blow-by-blow, leaving the aggressor, whoever it might be, with the initiative.

Our response would be to send elements of the Army chasing around the vast land mass of the north to find, engage and defeat this mischievous enemy. It is easy to see how we could become exhausted in following this futile strategy. Surely the maintenance of a strong offensive capability would make an aggressor think twice before embarking on such a venture – knowing he could be hit back in his own backyard if he dared. Indeed, if he did so, it would be more sensible for Australia to hit him hard rather than chasing him around the outback. But of course, catering for this lesser event appeals because it costs less, would not upset our neighbours and would stop the military trying to escalate the incident. That we would almost certainly lose is incidental.

The RAAF is almost a tiger. There are those who seek to keep it that way. Indeed, the reductions in flying hours of the F-IIIC and F/A-18 aircraft and the cutback in the number of aircrews announced in the review will be like extracting a couple of extra teeth. They take a long time to grow again. ■

## FIVE-MINUTE QUIZ

*Compiled by Kevin Schluter*

1 RSI is an abbreviation for which illness?
2 Name the band that includes brothers Neil and Tim Finn.
3 What substance is produced by mixing potassium nitrate, sulphur and charcoal?
4 Who, in March, won the US Academy Awards as Best Actor and Best Actress?
5 What prefix is added to "meter" to mean an instrument for measuring force or power?
6 Who wrote the poem that begins, *In Xanadu did Kubla Khan a stately pleasure dome decree*?
7 What type of bird is an Indian runner?
8 The word olfactory relates to which of the five senses?
9 TV character Doctor Who travelled through time in a vehicle named ...
10 Which motor-vehicle manufacturer has for its symbol a lion with its front paws on a sphere?

**Answers on page 120**